IMOS NETCDF USER'S MANUAL

NetCDF Conventions and Reference Tables

Version 1.2
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Table of contents

1 - OVERVIEW 1
1.1 - ABOUT IMOS 1
1.2 - ABOUT THIS DOCUMENT 1
1.3 - IMOS DATA MANAGEMENT STRUCTURE AND DATA ACCESS 2
2 - IMOS DATA FORMAT 2
3 - NETCDF FILE STRUCTURE 7
3.1 - GLOBAL ATTRIBUTES 7
3.1.1 - Definition 7
3.1.2 - List of the global attributes 7
3.1.3 - Time formats 14
3.1.3.1 - Actual time 14
3.1.3.2 - Time zone 15
3.1.3.3 - The reference time 15
3.1.4 - Global Attributes added by the user 15
3.2 - DATA FILE DIMENSIONS 16
3.3 - VARIABLES 17
3.3.1 - Coordinate variables 18
3.3.1.1 - TIME 18
3.3.1.2 - Location (X- Y horizontal Space) 21
3.3.1.2.1 - LATITUDE 21
3.3.1.2.2 - LONGITUDE 23
3.3.1.3 - DEPTH 25
3.3.2 - Data variables 28
3.3.3 - Ancillary variables 32
3.3.4 - Data variable attributes added by user 33
3.3.5 - Quality control (QC) 33
3.3.5.1 - Introduction 33
3.3.5.2 - Quality Control sets used by the IMOS project 33
3.3.5.3 - Definition of the variables and attributes 34
3.3.5.4 - Example of the <PARAM_QC> variable 34
3.3.5.5 - QC coordinate variables 36

3.3.6 - Uncertainty 37
3.3.6.1 - Introduction 37
3.3.6.2 - Definition of the uncertainty 37
3.3.6.3 - Example 38
3.3.7 - Example (see Appendix 1) 38

4 - IMOS METADATA FORMAT 39

4.1 - EMII MEST 39

5 - IMOS FILE NAMING CONVENTION 40

6 - REFERENCE TABLES 41

6.1 - IMOS PARAMETER DICTIONARY 41

6.2 - QUALITY CONTROL FLAG SCALE 45
6.2.1 - Introduction 45
6.2.2 - Quality Control Set 45
6.2.3 - SET 1 IMOS standard set using the IODE flags 46
6.2.4 - SET 2 ARGO quality control procedure 47
6.2.4.1 - ARGO measurement flag scale 47
6.2.4.2 - ARGO profile quality flags 48
6.2.5 - SET 3 BOM quality control procedure (SST and Air-Sea fluxes) 50

6.3 - CELL METHODS 51

7 - REFERENCES 52

APPENDIX 1: EXAMPLE NETCDF FILE 54

APPENDIX 2: IMOS NETCDF FILENAMING CONVENTION V 1.2 58

Index of Tables

Table 1 A CDL (Common Data Language) description of a netCDF file that contains data from the IMOS Ship of Opportunity Sea Surface Temperature Sub-Facility. CDL notation can be generated from netCDF files using the netCDF utility *ncdump*. 4

Table 2 List of mandatory and optional global attributes for IMOS NetCDF files 8

Table 3 List of Dimensions for IMOS NetCDF file 17

Table 4 List of attributes defining the TIME variable for IMOS NetCDF files 19

Table 5 List of attributes that define the LATITUDE variable for IMOS NetCDF files 21

Table 6 List of attributes to define LONGITUDE variable for IMOS NetCDf files 23

Table 7 List of attributes that define the DEPTH variable for IMOS NetCDF files 26

Table 8 List of data variables attributes for IMOS NetCDF files 29

Index of Reference Tables

Reference Table A : List of IMOS parameter names, standard names and units. Non-CF parameters are marked with the symbol "†". 42

Reference Table B : List of QC procedure flags used in the IMOS project 45

Reference Table C : IMOS standard set using the IODE flags 46

Reference Table D : ARGO measurement flag scale 47

Reference Table E : ARGO profile quality flags 48

Reference Table F : BOM Quality Control procedure flags (SST and Air Sea Fluxes) 50

Reference Table G : List of different cell methods, derived from the CF convention 51

PREFACE to version 1.2

eMII recently released version 1.1 of the NetCDF convention. In response to comments we have made a number of changes to the IMOS NetCDF user's manual. These minor changes are summarised below:

Global Attributes

- The attribute <date_modified> has been added (Table 2).
- The attribute <principal_investigator_name> has been renamed <principal_investigator> (Table 2).
- The attribute <principal_investigator_email> has been added (Table 2).
- Descriptions of the attributes <references> and <institution_references> have been clarified. Multiple references need to be separated with a semicolon (Table 2).
- The 'type' of the global attributes has been added to Table 2. The type values are **S** for string, **N** for numeric (byte, short, long, integer, float or double), **D** for the type of the data variable and **Q** for the type of the corresponding quality control data variable.

Variables

- The 'type' of the variable attributes has been added (Tables 4 to 9). The type values are S for string, N for numeric (byte, short, long, integer, float or double), D for the type of the data variable and Q for the type of the corresponding quality control data variable.
- The attribute <QC_set> has been renamed more clearly as <quality_control_set> (Tables 4, 5, 6, 7, 8 and 9).
- The attribute <QC_indicator> has been renamed more clearly as <quality_control_indicator> (Tables 4, 5, 6, 7, 8 and 9).
- The variable <PARAM_QC> has been renamed as <PARAM_quality_control> to be consistent with the name of the different QC attributes.
- The variable <PARAM_UNCERTAINTY has been renamed as <PARAM_uncertainty>.
- The attribute <conventions> used to define a <PARAM_quality_control> variable has been renamed to <quality_control_conventions>.

- The attribute <quality_control_set> has been added to define a <PARAM_quality_control>variable.

Other changes

- Some changes have been made to clarify use of standard names in section 6.1 and Reference Table A. Only parameters that appear in the CF standard name table (http://cf-pcmdi.llnl.gov/documents/cf-standard-names/) can use the <standard_name> attribute. Non-CF parameters (marked with the symbol "†" in Reference Table A) can only use the <long_name> attribute for their description.
- In Reference Table A, the parameter RAIN has been renamed as RRATE.
- In Reference Table A, the parameter RAIT has been renamed as RAIN_AMOUNT
- In Reference Table A, the parameter TURB has been added for Turbidity.
- Some minor changes have been made to Table 1 and to the example found in section 3.3.3 and in Appendix 1.
- The file naming convention (Appendix 2) has been updated to version (1.3).

PREFACE to version 1.1

In response to comments received following our distribution of version 1.0 we have made a number of changes to the IMOS netCDF user's manual. These changes are summarised below:

Global Attributes

- The global attribute <QC_indicator> has been removed from the convention (Table 2).
- The attribute <contact> has been removed and replaced with two new attributes : <data_centre_email> and <author_email> (Table 2).
- The attribute <PI_name> has been renamed more clearly as <principal_investigator_name> (Table 2).
- Use of the attribute <local_time_zone> is described more clearly in the text (Section 3.1.3.2).
- Description of the <keywords> attribute now specifies that GCMD keywords should be used where possible (Table 2).

Variables

- In version 1.0 we asked that variable names were all in capital letters. In version 1.1, variable names need not always be in capital letters (Section 3.3).
- An additional attribute was added to describe the <TIME> variable. This attribute is <calendar> and is used as defined in the CF-Convention (Eaton et al 2009) (Table 4).
- Two new variable attributes were added: <sensor_height> and <observation_type> (Table 8).
- The attribute <reference> has been renamed more clearly as <reference_datum> (Tables 5, 6, 7 and 8).
- A new section of the document describes the ancillary variables (QC and uncertainty) in detail, and when they should be used (Section 3.3.3).
- Use of the attributes QC_set and QC_indicator is described more clearly in the text in a new section on Quality Control (Section 3.3.5.3).

- A number of standardised parameter names/acronyms have been added to Reference Table A.

Other changes

- Some web links in the previous version were not working. These have been replaced in version 1.1 with working links.
- Additional references have been included in this version.
- The file naming convention (Appendix 2) has been updated to the most recent version (1.2).

1 - OVERVIEW

1.1 - About IMOS

IMOS is a distributed set of equipment and data-information services which collectively contribute to meeting the needs of marine climate research in Australia. The observing system provides data in the open oceans around Australia out to a few thousand kilometres as well as the coastal oceans. The IMOS Office coordinates the deployment of a wide range of equipment and assembles the data through 11 facilities distributed around the country. The data are made available to researchers through the electronic Marine information Infrastructure (eMII) located at the University of Tasmania. The IMOS infrastructure also contributes to Australia's role in international programs of ocean observing.

IMOS was planned through extensive consultation with the Australian marine research community through Nodes, including a Bluewater open ocean node and five regional nodes around the country.

IMOS is an initiative of the Australian Government being conducted as part of the National Collaborative Research Infrastructure Strategy. IMOS is coordinated nationally and managed by staff at the University of Tasmania.

1.2 - About this document

The main purpose of this document is to specify the format of the files that are used to distribute IMOS data, and to document the standards used therein. This includes naming conventions, or taxonomy, as well as metadata content.

The IMOS NetCDF convention manual is based on the one prescribed by the **OceanSITES** User's Manual, version 1.1. The **OceanSITES** program is the global network of open-ocean sustained time series reference stations that have been implemented by an international partnership of researchers. More information about this project is available at http://www.oceansites.org.

The IMOS NetCDF convention manual also draws on documents that have been produced for the IMOS project (see References).

1.3 - IMOS data management structure and data access

The eMarine Information Infrastructure (eMII) will provide a single integrative framework for data and information management that will allow discovery and access of the data by scientists, managers and the public.

eMII activity can be summarised as follows:

- eMII will host, manage and archive data produced by the other IMOS facilities.
- eMII will provide the standards, protocols and systems to integrate the data and related information into a number of conformal frameworks, and will provide the tools to access and utilise the data.
- For some kinds of data, eMII will provide data products as web services and web features for processing, integration and visualisation of data.
- Where possible, eMII will integrate data from sources outside IMOS into IMOS data products and export IMOS data to international programs.

2 - IMOS DATA FORMAT

Network Common Data Form (netCDF)

NetCDF is one of many file formats available for storing marine data. It is a relatively simple file format that is self-describing and portable. "Self-describing" means it contains data about the data (metadata), such as variable descriptions and units. "Portable" means that data in a dataset is represented in a form that can be accessed by computers with different methods of storing integers, characters and floating point numbers. It has a strong set of functional libraries that can be used to compress, subset and transform data. The netCDF software libraries and documentation are available online from Unidata [1]. Many netCDF manipulation and display software utilities are also available online.

NetCDF files contain the data as 'variables', which can be single numbers, vectors, or multi-dimensional arrays. Variables can be of data types: char (character), byte, short, int (integer), float or real, and double. NetCDF files contain data organised into a collection of named array variables along with named data file attributes. The format is widely applicable to many data types.

[1] http://www.unidata.ucar.edu/software/netcdf/

However, netCDF has some limitations. Some constraints exist on sizes of large variables. Also, the netCDF model does not support more than one unlimited dimension, nested data structures such as trees, nested arrays or other recursive structures. The Unidata NetCDF User's Guide thoroughly documents the many benefits and few limitations of NetCDF format (Rew et al 2008) [2] .

The IMOS NetCDF Convention has been written to be used when writing data files in netCDF Classic Format (version 3.6). Unidata released a netCDF-4 format in 2008. This format is more flexible than the classic format and offers additional features such as groups, compound types and variable length arrays. However, these files have a different underlying format to previous netCDF versions and cannot be read with any version of the netCDF library previous to 4.0. Unidata encourage the use of netCDF Classic Format to distribute data, for maximum portability (Rew et al 2008).

Common Data Language (CDL)

Common Data Language (CDL) is a human readable text notation that is used to describe the netCDF objects. The netCDF utility *ncdump* can be used to convert netCDF object binary to CDL text. The netCDF utility *ncgen* creates a netCDF binary file from a well-formed CDL text file.

A CDL description of a netCDF dataset takes the form:

```
netCDF name {
        dimensions: ….
        variables: ….
        data: ….
}
```

Where the name is used only as a default in constructing file names by the *ncgen* utility. The CDL description consists of three optional parts, each introduced by the keywords 'dimensions', 'variables' and 'data'. NetCDF dimension declarations appear after the dimensions keyword, netCDF variables and attributes are defined after the variables keyword, and variable data assignments appear after the data keyword. CDL statements are terminated by a semicolon. Spaces, tabs and new lines can be used freely for readability. Comments in CDL follow the characters '//' on any line (Rew et al 2008).

A simple CDL example which describes IMOS sea surface temperature data collected from a ship of opportunity is shown in Table 1.

[2] http://www.unidata.ucar.edu/software/netcdf/docs/netcdf

Table 1 A CDL (Common Data Language) description of a NetCDF file that contains data from the IMOS Ship of Opportunity Sea Surface Temperature Sub-Facility. CDL notation can be generated from NetCDF files using the NetCDF utility *ncdump*.

```
netcdf IMOS_SOOP-SST_T_20071120T150000Z_QLD12_FV01 {      // example CDL for NetCDF notation
dimensions:                                               // dimensions names are declared first
        TIME = 5;
        LONGITUDE = 3 ;
        LATITUDE = 2 ;
variables:                                                // variable types, names, dimensions and attributes
        double TIME(TIME) ;
                TIME:long_name = "time" ;
                TIME:units = "days since 1950-01-01T00:00:00Z" ;
                TIME:standard_name = "time" ;
        float LONGITUDE(LONGITUDE) ;
                LONGITUDE:long_name = "longitude" ;
                LONGITUDE:units = "degrees_east" ;
                LONGITUDE:standard_name = "longitude" ;
        float LATITUDE(LATITUDE) ;
                LATITUDE:long_name = "latitude" ;
                LATITUDE:units = "degrees_north" ;
                LATITUDE:standard_name = "latitude" ;
        float TEMP(TIME, LATITUDE, LONGITUDE) ;
                TEMP:long_name = "Water Temperature in degrees C" ;
                TEMP:units = "degree_Celsius" ;
                TEMP:standard_name = "sea_water_temperature" ;
                TEMP:_FillValue = 99999 ;
                TEMP:valid_min = -2.0 ;
                TEMP:valid_max = 40 ;
// global attributes:                                     // METADATA
                :project = "Integrated Marine Observing System" ;
                :title = "IMOS_SOOP-SST_T_20071120T150000Z_QLD12_FV01" ;
                :institution = "SOOP" ;
                :conventions = "IMOS version 1.2" ;
                :date_created = "200712100000" ;
                :source = "Ship observation" ;
                :keywords = "Oceans>Ocean Temperature>Water Temperature" ;
                :data_centre_email = "info@emii.org.au" ;
                :geospatial_lat_min = -35.0 ;
                :geospatial_lat_max = -36.0 ;
                :geospatial_lon_min = 151 ;
                :geospatial_lon_max = 152 ;
// data:                                                  // data assignments
                TIME = 0.5, 1.5, 2.5, 3.5, 4.5 ;
                LATITUDE = 54.2, 54.4, 54.6 ;
                LONGITUDE = 2.1, 2.5 ;
                TEMP = 34.5, 31.2, 23.7, 19.6, 35.8, 29.2, 24.4, 5.6, 7.2, 8.1, 18.6, 15.2, 13.1, 4.6, 3.7, 8.2, 9.7,
        34.2, 26.7, 28.7, 2.1, 3.4, 5.6, 7.8, 9.0, 10.2, 11.2, 11.6, 11.7, 11.8 ;
}
```

NetCDF conventions

IMOS uses the NetCDF Climate and Forecast (CF) Metadata Conventions v1.4 (Eaton et al 2009) wherever possible. However, sometimes it was desirable to incorporate attributes or concepts from other conventions to the IMOS convention. We have made clear notations in this document where the IMOS netCDF convention diverges from the CF convention.

Non-CF attribute

In tables, attributes that have not been derived from the CF convention are marked in the left margin of the page as shown here.

CF conventions require conforming datasets to contain sufficient metadata that they are self-describing, in the sense that each variable in the file has an associated description of what it represents, including physical units if appropriate, and that each value can be located in space (relative to earth based coordinates) and time (Eaton et al 2009). The CF convention supplies a standard vocabulary and some metadata conventions.

IMOS data format

The IMOS netCDF data format will enable the inclusion of standard terms for the short names of both coordinate and data variables (measurements). File names are created using an IMOS NetCDF filenaming convention (see Appendix 2). Coordinate variables, which describe the dimensions of a data set, are limited to a single set of 4-dimensional axes representing longitude, latitude, depth and time (X, Y, Z and T) dimensions in any single file. If data cannot all be put onto a single time axis, then separate files are created for these data.

An IMOS data file will be flexible enough to contain all IMOS data variables.

IMOS NetCDF file conventions require that:

- Units are compliant with CF/COARDS/Udunits;
- The time parameter is encoded as recommended by COARDS and CF;
- Parameters are given standard names from the CF table
- Where time is specified as an attribute, the ISO8601 standard is used.

For more information on CF, COARDS, NetCDF, Udunits, and ISO8601 see:

NetCDF: http://www.unidata.ucar.edu/software/netcdf/docs/BestPractices.html

Udunits: http://www.unidata.ucar.edu/software/udunits/

CF: http://cf-pcmdi.llnl.gov/

COARDS: http://ferret.wrc.noaa.gov/noaa_coop/coop_cdf_profile.html

ISO8601: http://en.wikipedia.org/wiki/ISO_8601

3 - NETCDF FILE STRUCTURE

3.1 - Global Attributes

3.1.1 -Definition

The global attribute section of a NetCDF file contains metadata that describes the overall contents of the file and allows for data discovery. All fields should be human-readable and can be of either 'character' or 'numeric' type. IMOS recommends that all listed attributes be used and contain meaningful information unless there are technical reasons rendering this impossible (for example, information not available for historical data). Files must at least contain the attributes listed as "mandatory". Please contact eMII if this is proving difficult.

Global attributes can be thought of as conveying five kinds of information:

- What: What are the data in the dataset
- Where: The spatial coverage of the data
- When: The temporal coverage of the data
- Who: Who produced the data
- How: How were the data produced and made available

3.1.2 -List of the global attributes

Table 2 lists all the global attributes used to define an IMOS dataset.

Mandatory fields are marked with an asterisk (*).

The "Type" values are **S** for string, **N** for numeric (byte, short, long, integer, float or double), **D** for the type of the data variable and **Q** for the type of the corresponding quality control data variable.

Table 2 List of mandatory and optional global attributes for IMOS NetCDF files

	Name	Type	Example	Definition
	What			
Non-CF attribute	* project	S	project = "Integrated Marine Observing System"	The scientific project that produced the data
	* conventions	S	conventions = "IMOS version 1.2"	Name of the format convention used by the dataset
	* title	S	title = "Radar data from Tannum Sands station, Queensland"	Short description of the dataset
	* institution	S	institution = "ACORN"	Name of the institute or facility where the original data was produced
Non-CF attribute	* date_created	S	date_created = "2008-11-23T08:35:00Z"	The date on which the data was created. See **chapter 3.1.3** on time format below.
Non-CF attribute	date_modified	S	date_modified = "2008-12-23T20:35:00Z"	The date on which the data was modified. See **chapter 3.1.3** on time format below. If this attribute is used for the first time or modified, a new entry needs to be added to the "history" attribute.
Non-CF attribute	* abstract	S	abstract = "……"	A paragraph describing the dataset: type of data contained in the dataset, how the data was created, the creator of the dataset, the project for which the data was created, the geospatial coverage of the data, the temporal coverage of the data. In some instances the abstract

			may be autogenerated from other netCDF fields. Please discuss this with eMII staff if you think autogeneration will be appropriate for your data.
history	S	history = "……."	Provides an audit trail for modifications to the original data. It should contain a separate line for each modification, with each line beginning with a timestamp and including user name, modification name and modification arguments.
comment	S	comment ="……."	Miscellaneous information about the data or methods used to produce it. Any free-format text is appropriate
source	S	Source = "Radar Observation"	Method of production of the original data
* keywords	S	keywords = "Oceans > Ocean Circulation > Ocean Currents , Oceans > Ocean Waves > Significant Wave Height ,…"	A comma separated list of key words and phrases. To be consistent with the MEST we recommend using the GCMD vocabulary (Olsen et.al., 2007). The GCMD keywords list can be downloaded from: http://gcmd.nasa.gov/Resources/valids/archives/keyword_list.html Non-GCMD keywords may be used at your discretion
references	S	references =	Published or web-based references that describe the

Non-CF attribute

			"http://www.imos.org.au"	data or the methods used to produce the data. Include a reference to IMOS and a project-specific reference if appropriate. Multiple references should be separated with a semicolon ";".
Non-CF attribute	netcdf_version	N	netcdf_version = 3.5	NetCDF version used for the dataset
Non-CF attribute	quality_control_set	N	quality_control_set = 1	Definition of the Quality control set used for the data, if the same for all variables See IMOS Reference Table B
Non-CF attribute	site_code	S	site_code = "……."	Name of the site within IMOS project.
Non-CF attribute	platform_code	S	platform_code = "TAN"	Platform unique code within IMOS project. The platform codes are listed in Naming Reference Table 3 in Appendix 2 "File naming convention for netCDF files".
Non-CF attribute	naming_authority	S	naming_authority = "IMOS"	This will always be "IMOS"
Non-CF attribute	cdm_data_type	S	cdm_data_type = "Station"	The "cdm_data_type" attribute gives the Unidata CDM (Common Data Model) data type used by THREDDS. E.g. "Point", "Trajectory", "Station", "Radial", "Grid", "Swath". More information on http://www.unidata.ucar.edu/projects/THREDDS/CDM/CDM-TDS.htm

Non-CF attribute	metadata	S	metadata = " http://....."	URL to the metadata record corresponding to the netCDF file. eMII are considering adding this information to the data files as part of eMII data processing. Facilities would not be required to complete these fields when submitting data.
Non-CF attribute	sensorML	S	sensorML = " http://....."	Link to the sensorML record corresponding to the netCDF file. eMII are considering adding this information to the data files as part of eMII data processing. Facilities would not be required to complete these fields when submitting data.
Non-CF attribute	**Where**			
	* geospatial_lat_min	N	geospatial_lat_min = 59.8	The southernmost latitude, a value between -90 and 90 degrees.
	* geospatial_lat_max	N	geospatial_lat_max = 59.8	The northernmost latitude, a value between -90 and 90 degrees.
	* geospatial_lon_min	N	geospatial_lon_min =-41.2	The westernmost longitude, a value between -180 and 180 degrees.
	* geospatial_lon_max	N	geospatial_lon_max=-41.2	The easternmost longitude, a value between -180 and 180 degrees.

	*geospatial_vertical_min	N	geospatial_vertical_min = 10.0	Minimum depth for measurements
	*geospatial_vertical_max	N	geospatial_vertical_max = 2000	Maximum depth for measurements
Non-CF attribute	**When**			
	*time_coverage_start	S	time_coverage_start = "2008-11-23T08:35:00Z"	Start date of the data in UTC. See chapter 3.1.3 on time format below
	*time_coverage_end	S	time_coverage_end = "2008-11-23T08:35:00Z"	Final date of the data in UTC. See chapter 3.1.3 on time format below
	local_time_zone	N	local_time_zone = 10	Local time zone. See chapter 3.1.3 on time format below. If local time does not fall into one zone for the full dataset, do not use this attribute.
Non-CF attribute	**Who**			
	data_centre	S	data_centre = "eMarine Information Infrastructure (eMII)"	Data centre in charge of the data management or party who distributed the resource
	*data_centre_email	S	data_centre_email = "info@emii.org.au"	Data Centre contact e-mail address
	author_email	S	author_email = "acorn@emii.org.au"	NetCDF file author contact e-mail address
	author	S	author = "John Doe"	Name of the person responsible for the creation of the dataset
	*principal_investigator	S	principal_investigator = "John Doe"	Name of the principal investigator in charge of the platform

	principal_investigator_email	S	principal_investigator_email = "john.doe@utas.edu.au"	Principal Investigator e-mail address
	institution_references	S	institution_references = "http://imos.org.au/emii.html"	References that describe the data provider institution, the place to find all information on the dataset (web-based, i.e. give URLs). Multiple references should be separated with a semicolon ";".
Non-CF attribute	**How**			
	citation	S	citation = Integrated Marine Observing System. 2008, "Australian Acoustic Tagging and Monitoring System (AATAMS) data", http://imos.org.au/emii_aatams.html, accessed 20 Dec 2008.	The citation to be used in publications using the dataset should follow the format: "IMOS. [year-of-data-download], [Title], [Data access URL], accessed [date-of-access]".
	acknowledgement	S	acknowledgement = "Data was sourced from the Integrated Marine Observing System (IMOS) - an initiative of the Australian Government being conducted as part of the National Collaborative Research Infrastructure Strategy."	Any users (including re-packagers) of IMOS data are required to clearly acknowledge the source of the material in this format.
	distribution_statement	S	distribution_statement = SOTS data may be re-	Statement describing data distribution policy:

		used, provided that related metadata explaining the data has been reviewed by the user, and the data is appropriately acknowledged. Data, products and services from IMOS are provided "as is" without any warranty as to fitness for a particular purpose.	Re-packagers of IMOS data should include a statement that information about data quality and lineage is available from the metadata record and a statement that data, products and services from IMOS are provided "as is" without any warranty as to fitness for a particular purpose.

3.1.3 -Time formats

Time consists of three components:

- The actual time as hours, minutes and seconds
- The time zone of the location at which the measurement was made
- The reference point against which the time is measured

3.1.3.1 - Actual time

All time will be recorded in hours, minutes, seconds and decimal fractions of seconds relative to UTC that is Universal Time Coordinate or the old GMT.

Whenever time information is given in the global attributes, it ought to be a string of the format: "YYYY-MM-DDThh:mm:ssZ" (i.e. year – month – day T hour : minute : second Z)

If higher resolution than seconds is needed, any number of decimal digits (".s") for the seconds is acceptable: "YYYY-MM-DDThh:mm:ss.sZ"

Time will be recorded using the international standard ISO 8601 (International Organization for Standardization, 2009). Examples of the time format are shown below.

2005-10-24T08:00:00Z

2008-01-01T22:50:02.03Z

3.1.3.2 - Time zone

The time zone value gives the local time which is important in considering many biological processes and phenomena. For example, we may measure time as hours, minutes and seconds from a reference such as UTC but to be able to relate that to local diurnal processes we also need to know the local time zone.

The local time zone will be recorded as the hours plus or minus from the longitude meridian.

Examples of the time format are shown below:

2008-10-24T08:00:00Z (UTC)

2008-10-24T18:00:00+10 (Local)

The value (eg. +10) should be included in the global attribute local_time_zone.

Corrections from local to UTC time for Australian time zones can be found online at:

http://www.timeanddate.com/worldclock/timezone.html?n=396

The global attribute 'local_time_zone' should be used only when all data points in a dataset are from the same local time zone. If time zone changes during the dataset (e.g. moving point measurements on a ship of opportunity) then do not use this global attribute. Instead, advanced users may choose to create a user-defined variable called 'local_time_zone'. If local time zone is not defined in the dataset, it will be calculated by data users from the lat/long coordinate and UTC time variables.

3.1.3.3 - The reference time

This value represented the reference point against which the time is measured. This value will be used in the next chapter and particularly in the attributes representing the coordinate variables.

eMII suggests that all the IMOS data should use the ARGO reference time of 1st of January of 1950. The value will be stored as the number of days since this reference time.

3.1.4 -Global Attributes added by the user

The global attributes listed in the table in the chapter 3.1.2 are most important to define a dataset as clearly as possible. However, this list will not in all cases be exhaustive and eMII requests that other meaningful global attributes be used where necessary.

It is possible to add global attributes to meet specific facility needs. New attributes will need to be self defined, including a description and an example of how it is used. User-defined global attributes should be added to the existing list (Table 2) in the next version of the IMOS NetCDF User's manual.

An example of an 'user defined' global attribute and supporting information is below:

This example can be used by the ACORN facility to illustrate the kind of data and the type of radar used to produce the data. The prefix "ssr" added to each attribute means "sea surface radar".

ssr_Data_Type = "Range_Time_Series"

ssr_Radar = "Helzel/WERA"

3.2 - Data File Dimensions

NetCDF file dimensions provide information on the number and size of the data variables. IMOS allows a single variable for each of the data dimensions, i.e. time, depth, latitude and longitude. There may only be one unlimited dimension, i.e. as many instances of this variable as needed, for a limited number of coinciding variables. Other dimensions may be greater than 1, but must be defined and may not be unlimited. Coordinate types other than latitude, longitude, depth and time are allowed.

The example in Table 3 allows for measurements at an unlimited number of time steps, at five different depths and one latitude, longitude, position, frequency and direction.

Requirements are described further in the section on coordinate variables (3.3.1).

Table 3 An example list of Dimensions for an IMOS NetCDF file

Name	Example	Comment
TIME	TIME = unlimited	Number of time steps
DEPTH	DEPTH = 5	Number of depth levels
LATITUDE	LATITUDE = 1	Dimension of the latitude coordinate variable
LONGITUDE	LONGITUDE = 1	Dimension of the longitude variable
POSITION	POSITION = 1	Dimension of the POSITION variable
FREQUENCY	FREQUENCY = 1	Number of frequency levels
DIRECTION	DIRECTION = 1	Number of direction levels

3.3 - Variables

NetCDF variables include data measured by instruments, parameters derived from the primary measurements and coordinate variables, which may be nominal values such as values for depth for instruments that do not directly record depth. Defined variable names are listed in Reference Table A. Each variable has a specific set of attributes, some of which are mandatory.

The "Type" values are **S** for string, **N** for numeric (byte, short, long, integer, float or double), **D** for the type of the data variable and **Q** for the type of the quality control data variable.

This section will be divided into 5 different sub-sections as listed below:

- The coordinate variables
- The data variables
- Quality control 'sets'
- Defining uncertainties in data measurement
- An example of a NetCDF header.

3.3.1 -Coordinate variables

The coordinate variables orient the data in time and space. For this purpose, they have an "axis" attribute defining that they point in X, Y, Z and T dimensions. The X and Y of course represent horizontal space while for oceanography Z is depth and T is time.

The use of a common set of spatial and temporal units and measures is the basic requirement to be able to integrate the various data collected by the IMOS project.

3.3.1.1 - TIME

All time will be recorded in hours, minutes, seconds and decimal fractions of seconds relative to UTC that is Universal Time Coordinate or the old GMT.

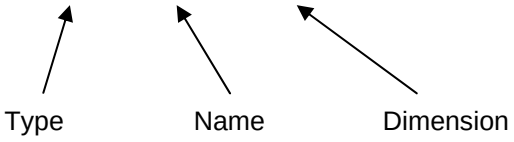
Time consists of three components:

- The actual time as hours, minutes and seconds
- The time zone of the location at which the measurement was made
- The reference point against which the time is measured

The third component is used to define the reference point in the attribute named "units".

To identify the time variable, three parameters are used: Type, Name and Dimension.

Example : Double TIME(TIME)



The following table presents the different attributes used to represent the time variable. Mandatory fields are marked with an asterisk (*)

Table 4 List of attributes defining the TIME variable for IMOS NetCDF files

Attributes	Type	Example	Comment
* standard_name	S	standard_name="time"	A standard name that references a description of a variable's content in the standard name table
* long_name	S	long_name = " time "	A descriptive name that indicates a variable's content. This name is not standardized.
* units	S	units = "days since 1950-01-01T00:00:00Z"	Units of a variable's content. Date and time (UTC) of the measurement in days since 1950-01-01 00:00:00 Example :Noon, Jan 2, 1950 is stored as 1.5 July 25, 2001, 19:14:00 is stored as 18833.8013889 Please contact eMII if you require help with this conversion: info@emii.org.au
* axis	S	axis = "T"	Identifies time axes
* valid_min	N	valid_min = 0	Smallest valid value of a variable
* valid_max	N	valid_max = 90000.0	Largest valid value of a variable
* _FillValue	D	_FillValue = 99999.0	A value used to represent missing or undefined data [3]

[3] Some users will create netCDF files with Matlab which contain a "not-a-number" (NaN) fill value. We ask that this NaN value be replaced with a float value e.g. _FillValue of 999999.

	calendar	S	calendar = "gregorian"	Calendar used for encoding time axes. See Eaton et. al. 2009 for clarification.
	comment	S	comment = "……."	Miscellaneous information about the data or methods used to produce it.
Non-CF attribute	*quality_control_set	N	quality_control_set = 1	A value representing the Quality control set used to the data. See IMOS Reference Table B.
Non-CF attribute	quality_control_indicator	Q	quality_control_indicator = <X>	This attribute may be used if the quality of 'time' data is constant throughout the dataset. This allows user to quickly assess if all the data is good, without looking at the _quality_control variable. However, the quality control variable TIME_quality_control **must** still be defined as discussed in section 3.3.5. See IMOS Reference Tables C to F.
Non-CF attribute	uncertainty	N	uncertainty = <Z>	<Z> : Overall measurement uncertainty. Choose appropriate value. See section 3.3.6.
Non-CF attribute	local_time_zone	N	local_time_zone =+10	A value used to represent the local time zone if it remains constant throughout the dataset.

Example :

Double TIME(TIME) ;
TIME:long_name = "time" ;
TIME:standard_name = "time" ;
TIME:units = "days since 1950-01-01T00:00:00Z" ;
TIME:axis = "T" ;

TIME:valid_min = 0 ;
TIME:valid_max = 90000.0 ;
TIME:_FillValue = 99999.0 ;
TIME:calendar = "gregorian"
TIME:quality_control_set = 1
TIME:quality_control_indicator = 1
TIME:uncertainty = 0.003
TIME:local_time_zone = +10

3.3.1.2 - Location (X- Y horizontal Space)

With the advent of GPS systems, it is now possible to measure position in space easily and accurately.

The location will be measured by GPS or equivalent as Latitude/Longitude in Decimal degrees using the WGS84 projection with locations south of the equator as negative values and values west of zero degrees of Longitude being negative.

Table 5 and Table 6 present the different attributes used to define the variables LATITUDE and LONGITUDE.

3.3.1.2.1 - LATITUDE

Table 5 List of attributes that define the LATITUDE variable for IMOS NetCDF files

Attributes	Type	Example	Comment
* standard_name	S	standard_name = "latitude"	A standard name that references a description of a variable's content in the standard name table Latitude of the measurements
* long_name	S	long_name = "latitude"	A descriptive name that indicates a variable's content. This name is not standardized.

	* units	S	units = "degrees_north"	Units: degrees north ; southern latitudes are negative Example : -44.4991 for 44 29' 56.76" S
	* axis	S	axis = " Y "	Identifies Y axes
	* valid_min	N	valid_min = -90	Smallest valid value of a variable
	* valid_max	N	valid_max = 90	Largest valid value of a variable
	* _FillValue	D	_FillValue = 99999.0	A value used to represent missing or undefined data[4]
	comment	S	comment = " ……."	Miscellaneous information about the data or methods used to produce it.
Non-CF attribute	*quality_control_set	N	quality_control_set = 1	A value representing the Quality control set used to the data. . See IMOS Reference Table B.
Non-CF attribute	quality_control_indicator	Q	quality_control_indicator = <X>	This attribute may be used if the quality of 'latitude' data is constant throughout the dataset. This allows user to quickly assess if all the data is good, without looking at the _quality_control variable. However, the variable LATITUDE_quality_control **must** still be defined. See IMOS Reference Tables C to F.

[4] Some users will create netCDF files with Matlab which contain a "not-a-number" (NaN) fill value. We ask that this NaN value be replaced with a float value e.g. _FillValue of 99999.

Non-CF attribute	uncertainty	N	uncertainty = <Z>	<Z> : Overall measurement uncertainty. Choose appropriate value. See section 3.3.6.
Non-CF attribute	* reference_datum	S	reference_datum = "geographical coordinates, WGS84 projection"	Text description of the geographic reference datum for the variable

Example:

Float LATITUDE(LATITUDE) ;
LATITUDE:long_name = "latitude" ;
LATITUDE:standard_name = "latitude" ;
LATITUDE:units = "degrees_north" ;
LATITUDE:axis = "Y" ;
LATITUDE:valid_min = -90 ;
LATITUDE:valid_max = 90 ;
LATITUDE:_FillValue = 99999.0 ;
LATITUDE:quality_control_set = 1
LATITUDE:quality_control_indicator = 1
LATITUDE:uncertainty = 0.001
LATITUDE:reference-datum = "geographical coordinates, WGS84 projection"

3.3.1.2.2 - LONGITUDE

Table 6 List of attributes to define LONGITUDE variable for IMOS NetCDF files

Attributes	Type	Example	Comment
* standard_name	S	standard_name = "longitude "	A standard name that references a description of a variable's content in the standard name table Longitude of the measurements
* long_name	S	long_name = "longitude"	A descriptive name that indicates a variable's content.

			This name is not standardized.
* units	S	units = "degrees_east"	Units: degrees east ; western longitudes are negative Example : -16.7222 for 16 43' 19.92" W
* axis	S	axis = " X "	Identifies X axes
* valid_min	N	valid_min = -180	Smallest valid value of a variable
* valid_max	N	valid_max = 180	Largest valid value of a variable
* _FillValue	D	_FillValue = 99999.0	A value used to represent missing or undefined data[5]
comment	S	comment = " ……."	Miscellaneous information about the data or methods used to produce it.
*quality_control_set	N	quality_control_set = 1	A value representing the Quality control set used to the data. . See IMOS Reference Table B.
quality_control_indicator	Q	quality_control_indicator = <X>	This attribute may be used if the quality of 'longitude' data is constant throughout the dataset. This allows user to quickly assess if all the data is good, without looking at the _quality_control variable. However, the variable LONGITUDE_quality_control **must** still be defined.. See IMOS Reference Tables C to F.

Non-CF attribute

Non-CF attribute

[5] Some users will create netCDF files with Matlab which contain a "not-a-number" (NaN) fill value. We ask that this NaN value be replaced with a float value e.g. _FillValue of 99999.

Non-CF attribute	uncertainty	N	uncertainty = <Z>	<Z> : Overall measurement uncertainty. Choose appropriate value. See section 3.3.6.
Non-CF attribute	* reference_datum	S	reference_datum = "geographical coordinates, WGS84 projection"	Text description of the geographic reference datum for the variable

Example:

Float LONGITUDE(LONGITUDE) ;
LONGITUDE:long_name = "longitude" ;
LONGITUDE:standard_name = "longitude" ;
LONGITUDE:units = "degrees_east" ;
LONGITUDE:axis = "X" ;
LONGITUDE:valid_min = -180 ;
LONGITUDE:valid_max = 180 ;
LONGITUDE:_FillValue = 99999.0 ;
LONGITUDE:quality_control_set = 1
LONGITUDE:quality_control_indicator = 1
LONGITUDE:uncertainty = 0.001
LONGITUDE:reference_datum = "geographical coordinates, WGS84 projection"

3.3.1.3 - DEPTH

Depth will be measured as positive values with increasing depth as measured from a reference point or datum. Two datums are recognised: depth from Mean Sea Level (MSL) and depth from the surface (in which case the time and location of the data will need to be included to allow for tide corrections). Where depth is measured as distance from the bottom this should be converted into one of the two acceptable datums.

All depth measurements will be recorded as the reference datum and the offset or distance from that reference, such as metres below the surface or metres below MSL.

Depth should be measured in metres or other SI units. Depth measured as pressure should be converted to metres and not left as pressure; if the pressure measurements are required these should be recorded as a separate data stream. It is not permissible to label a pressure measurement as "depth"; a depth measurement will always be in metres.

Table 7 presents the different attributes used to describe the DEPTH variable.

Table 7 List of attributes that define the DEPTH variable for IMOS NetCDF files

Attributes	Type	Example	Comment
* standard_name	S	standard_name = "depth"	A standard name that references a description of a variable's content in the standard name table Depth of each measurement
* long_name	S	long_name = "depth"	A descriptive name that indicates a variable's content. This name is not standardized.
* units	S	units = " metres "	Example : 513 for a measurement 513 metres below reference datum, e.g. MSL
* axis	S	axis = " Z "	Identifies Z axes
* positive	S	positive = "down "	Direction of increasing vertical coordinate value. Z axes may be positive = "up" (atmospheric) or negative = "down" (oceanic)
* valid_min	N	valid_min = 0	Smallest valid value of a variable
* valid_max	N	valid_max = 12000	Largest valid value of a

				variable
	* _FillValue	D	_FillValue = -99999.0	A value used to represent missing or undefined data[6]
	comment	S	comment = " ……."	Miscellaneous information about the data or methods used to produce it.
Non-CF attribute	* quality_control_set	N	quality_control_set = 1	A value representing the Quality control set used to the data. . See IMOS Reference Table B.
Non-CF attribute	quality_control_indicator	Q	quality_control_indicator = <X>	This attribute may be used if the quality of 'depth' data is constant throughout the dataset. This allows user to quickly assess if all the data is good, without looking at the _quality_control variable. However, the variable DEPTH_quality_control **must** still be defined.. See IMOS Reference Tables C to F.
Non-CF attribute	* uncertainty	N	uncertainty = <Z>	<Z> : Overall measurement uncertainty. Choose appropriate value. See section 3.3.6.
Non-CF attribute	* reference_datum	S	reference_datum = "Mean Sea Level (MSL)"	Text description of the reference datum for the variable

[6] Some users will create netCDF files with Matlab which contain a "not-a-number" (NaN) fill value. We ask that this NaN value be replaced with a float value e.g. _FillValue of 99999.

Example:

Float DEPTH(DEPTH) ;

DEPTH:long_name = "depth of each measurement" ;
DEPTH:standard_name = "depth" ;
DEPTH:units = "metres" ;
DEPTH:axis = "Z" ;
DEPTH:positive = "down" ;
DEPTH:valid_min = 0 ;
DEPTH:valid_max = 12000 ;
DEPTH:_FillValue = -99999.0 ;
DEPTH:quality_control_set = 1
DEPTH:quality_control_indicator = 1
DEPTH:uncertainty = 0.001
DEPTH:reference_datum = "Mean Sea Level (MSL)"

3.3.2 -Data variables

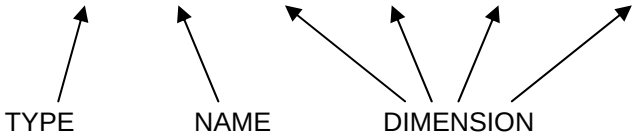
The variable names are standardized in IMOS Reference Table A. For example, TEMP represents the sea water temperature and PSAL represent the sea water salinity. The data variables should begin with a letter and be composed of letters, digits and underscores.

To identify a variable, three parameters are used: type, Name and Dimension. In data variable definitions, the dimensions (TIME, DEPTH, LATITUDE, LONGITUDE) must be used in this order (if present) as they appear in CDL. When "extra" dimensions are used, such as with model runs, they should appear to the left of the standard dimensions in a variable definition.

In some cases, two instruments may measure the same variable (e.g. wind speed measured by two anemometers mounted on the same vessel). In these cases, the second instance of a variable should be identified with the suffix '_2'. When wind speed is measured twice the variables would be defined as WSPD and WSPD_2. Several variable attributes can be used to specify the differences, including comments, descriptive attributes (sensor_depth, sensor_height) and long names. Two anemometers might be distinguished in their long names as wind_speed_starboard and wind_speed_port.

Example for the sea water temperature:

Float TEMP(TIME, DEPTH, LATITUDE, LONGITUDE)



The following table presents the different attributes used to represent a specific variable. Mandatory fields are marked with an asterisk (*)

Table 8 List of data variables attributes for IMOS NetCDF files

Attributes	Type	Example	Comment
* standard_name	S	standard_name = "sea_surface_temperature"	A standard name that references a description of a variable's content in the standard name table. See Reference Table A.
* units	S	units = "Celsius"	Units
* _FillValue	D	_FillValue = 99999	A value used to represent missing or undefined data[7]
long_name	S	long_name = " Surface temperature in degree Celsius"	A descriptive name that indicates a variable's content. This name is not standardized.
valid_min	N	valid_min = -2.0	Minimum value for valid data
valid_max	N	valid_max = 40	Maximum value for valid data
add_offset	N	add_offset = 25	If present for a variable, this number is to be added

[7] Some users will create netCDF files with Matlab which contain a "not-a-number" (NaN) fill value. We ask that this NaN value be replaced with a float value e.g. _FillValue of 99999.

				to the data after it is read by an application. If both scale_factor and add_offset attributes are present, the data are first scaled before the offset is added.
	scale_factor	N	scale_factor = 0.01	If present for a variable, the data are to be multiplied by this factor after the data are read by an application.
Non-CF attribute	original_units	S	original_units = "……"	Original units of a variable's content
Non-CF attribute	original_name	S	original_name = "……"	Original name of a variable
	comment	S	comment = "……."	Miscellaneous information about the data or methods used to produce it
	history	S	history = "……."	List of application that have modified the original data
	references	S	references = "……."	References that describe the data or methods used to produce it. Multiple references should be separated with a semicolon.
	ancillary_variables	S	ancillary_variables = "TEMP_quality_control"	Identifies a variable that contains closely associated data, e.g. the measurement uncertainties of instrument data. See section 3.3.3.
Non-CF attribute	sensor_depth	N	sensor_depth = 0	Nominal sensor depth(s) in metres counting positive as per the attribute DEPTH:positive

Non-CF attribute	sensor_height	N	sensor_height = 2	Nominal sensor height(s) in metres counting positive as per the attribute DEPTH:positive
Non-CF attribute	observation_type	S	observation_type = "measured"	Type of observation. If for example, the variable is measured or calculated.
Non-CF attribute	uncertainty	N	uncertainty = 0.001	Overall measurement uncertainty, if constant. Cf paragraph 3.3.6.
Non-CF attribute	accuracy	N	accuracy = 0.01	Nominal sensor accuracy. Cf. paragraph 3.3.6.
Non-CF attribute	precision	N	precision = 0.01	Nominal sensor precision. Cf paragraph 3.3.6.
Non-CF attribute	resolution	N	resolution = 0.01	Nominal resolution of this data parameter. Cf paragraph 3.3.6.
	cell_methods	S	cell_methods = "point"	Records the method used to derive data that represents cell values. See section 6.3 and Reference Table G for more information
	reference_datum	S	reference_datum = "……."	Text description of the reference datum for the variable
Non-CF attribute	quality_control_set	N	quality_control_set = 1	A value representing the Quality control set used to the data. See IMOS Reference Table B.
Non-CF attribute	quality_control_indicator	Q	quality_control_indicator = <X>	If the data quality is constant, this additional attribute is used. The

			variable <PARAM_quality_control> still need to be defined. See IMOS Reference Tables C to F.

3.3.3 - Ancillary variables

When one data variable provides metadata about the individual values of another data variable it may be desirable to express this association by providing a link between the variables. For example, instrument data may have associated measures of uncertainty; data points may have associated quality control flags. The attribute "ancillary_variable" is used to express these types of relationships.

The use of ancillary variables in the context of data Quality Control and uncertainty are described in sections 3.3.5 and 3.3.6.

Example:

float TEMP(TIME, DEPTH, LATITUDE, LONGITUDE) ;
TEMP:long_name = "Water Temperature in degrees C" ;
TEMP:units = "Celsius" ;
TEMP:standard_name = "sea_water_temperature" ;
TEMP:_FillValue = 99999 ;
TEMP:ancillary_variables = "TEMP_quality_control TEMP_uncertainty";
byte TEMP_quality_control(TIME, DEPTH, LATITUDE, LONGITUDE) ;
TEMP_quality_control:standard_name = "sea_water_temperature status_flag" ;
TEMP_quality_control:convention = "IMOS standard set using IODE flags";
TEMP_quality_control:_FillValue = -10 ;
TEMP_quality_control:flag_values = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 ;
TEMP_quality_control:flag_meanings = "no_qc_performed good_data probably_good_data bad_data_that_are_potentially_correctable bad_data value_changed not_used not_used interpolated_value missing_value";
float TEMP_uncertainty(TIME, DEPTH, LATITUDE, LONGITUDE) ;
TEMP_uncertainty:long_name = "Uncertainty of water temperature" ;
TEMP_uncertainty:units = "Celsius" ;
TEMP_uncertainty:standard_name = "sea_water_temperature standard_error" ;
TEMP_uncertainty:_FillValue = 99999 ;

3.3.4 - Data variable attributes added by user

User defined data variables will be included in future versions of the NetCDF document. This document will be revised regularly and new user-defined data variable attributes incorporated into Table 8.

3.3.5 - Quality control (QC)

3.3.5.1 - Introduction

Quality control involves some sort of assessment of the data to identify data points or even data sets which have errors that limit their use. The basic approach used by IMOS is to keep all of the data but to flag data or data sets that do not meet the quality assessment standards of data collectors / principal investigators. Quality Control is a complex area and one that will be implemented in a more sophisticated manner as the project progresses. We present here the basic requirements for QC of IMOS data.

Most IMOS facilities are currently using a quality control procedure. eMII will not proscribe changes to procedures that are already in use. On the other hand, it is appropriate that all IMOS facilities use the same convention to qualify their quality control procedures: for example, the naming of the QC variables or the naming of possible variable attributes.

This section will present the different Quality Control procedures currently used within the IMOS project. It will also present the different attributes and the variables available to define a quality control procedure.

3.3.5.2 - Quality Control sets used by the IMOS project

The global attribute **quality_control_set** will enable users to define which Quality Control procedure was applied to the dataset. Please see Reference Table B. Additional QC sets may be added to this table in future versions of this document.

The first set of Quality Control flags in Reference Table B corresponds to an IMOS-wide standard set of QC flags, the IODE flags (See Reference Table C).

According to Table B, a value equal to 2 will define that the ARGO quality control procedure was used for the dataset.

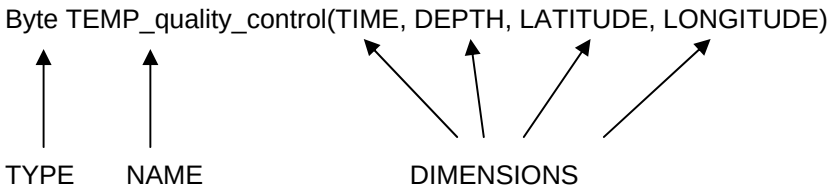
3.3.5.3 - Definition of the variables and attributes

The IMOS convention requires that "_quality_control" ancillary variables are used to flag all data points contained in each dataset with a Quality Control flag from a selected quality_control_set. The attribute <PARAM>:quality_control_set is used to define which quality control set was used for the dataset (Reference Table B). The quality of the data in a variable <PARAM> is described by the ancillary variable <PARAM_quality_control>. This variable will contain values describing the data quality as per flag_meanings in Table 9, below. It is mandatory that the attribute <PARAM>:quality_control_set and the variable <PARAM_quality_control> are defined.

In addition to the ancillary <PARAM_quality_control> variable, the optional attribute <PARAM>:quality_control_indicator may be used if the quality is the same for the entire variable. <PARAM>:quality_control_indicator will contain only one value describing the aggregated data quality of all data points for that variable.

To identify a QC variable, three parameters are used: Type, Name and Dimension.

Example for sea water temperature:



3.3.5.4 - Example of the <PARAM_quality_control> variable

The variable <PARAM_quality_control> contains quality flags for values of associated <PARAM>. Table 9 lists all the attributes used to define a Quality Control variable. The Table also includes an example using the quality control set 1 (IMOS standard set using IODE flags).

Table 9 List of attributes used to define a Quality Control variable

Attributes	Type	Example	Comment
* long_name	S	long_name = " quality flag for sea_surface_temperature"	Non-standardised name of variable
*standard_name	S	standard_name = "sea_surface_temperature status_flag"	Standardised name (status_flag suffix) of QC variable using the CF convention

* quality_control_set	N	quality_control_set = 1	A value representing the Quality Control set used to the data.. See IMOS reference Table B
* quality_control_conventions	S	quality_control_conventions ="IMOS standard set using the IODE flags"	Quality Control convention used, in this case the chosen QC set. See IMOS reference table B.
* _FillValue	D	_FillValue = 99999	Value used to represent missing QC flags[8]
* valid_min	N	valid_min = 0	The minimum value for valid data
* valid_max	N	valid_max = 9	The maximum value for valid data
* flag_values	D	flag_values = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9	The possible value for each data
* flag_meanings	S	flag_meanings = no_qc_performed good_data probably_good_data bad_data_that_are_potentially_correctable bad_data value_changed not_used not_used	One meaning is associated to each flag value :

[8] Some users will create netCDF files with Matlab which contain a "not-a-number" (NaN) fill value. We ask that this NaN value be replaced with a float value e.g. _FillValue of 99999.

		interpolated_value missing_value	

Example:

Byte TEMP_quality_control(TIME, DEPTH, LATITUDE, LONGITUDE) ;

TEMP_quality_control:long_name = "quality flag for sea_surface_temperature" ;

TEMP_quality_control:standard_name = "sea_surface_temperature status_flag" ;

TEMP_quality_control:quality_control_set = 1 ;

TEMP_quality_control:quality_control_conventions = "IMOS standard set using IODE flags"

TEMP_quality_control:_FillValue = -128 ;

TEMP_quality_control:valid_min = 0 ;

TEMP_quality_control:valid_max = 9 ;

TEMP_quality_control:flag_values = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 ;

TEMP_quality_control:flags_meanings =

no_qc_performed good_data probably_good_data bad_data_that_are_potentially_correctable bad_data value_changed not_used not_used interpolated_value missing_value;

3.3.5.5 - QC coordinate variables

The coordinate variables (TIME, DEPTH, LATITUDE and LONGITUDE) utilise the same quality control variables as the data variables. If the quality control values are constant throughout the dataset, the information may also be summarised using the quality_control_indicator attribute.

To identify a QC coordinate variable, three parameters are used: Type, Name and Dimension.

Example for the TIME, LATITUDE, LONGITUDE and DEPTH variables:

Byte TIME_quality_control(TIME);

Byte LATITUDE_quality_control(LATITUDE)

Byte LONGITUDE_quality_control(LONGITUDE);

Byte DEPTH_quality_control(DEPTH)

3.3.6 -Uncertainty

3.3.6.1 - Introduction

The term uncertainty is here defined as "the parameter, associated with the result of a measurement that characterises the dispersion of the values that could reasonably be attributed to the measurand" (Underwood, 2008).

The document "IMOS Data Streams and their Uncertainties" (Underwood, 2008) contains a calculation or estimation of the uncertainty for each data stream that will be provided by IMOS. When this document was created, a small number of data streams were still to be agreed upon, rendering it unfeasible to quantify errors for these streams. As the information on these data streams becomes available, it will be included in this document.

The document "IMOS Data Streams and their Uncertainties" is divided into three sections. The first section consists of a table that lists the uncertainty for each IMOS data stream, grouped by the parameter being measured. The second section is arranged by individual IMOS facility. It contains more information on the uncertainties, the instruments to be used and how the uncertainties are calculated and supported. The third section contains information relating to classes of instruments that are used across several IMOS facilities as well as some general comments on calibration issues.

A copy of this document is available from the IMOS website:

http://imos.org.au/reports0.html

3.3.6.2 - Definition of the uncertainty

If the overall measurement uncertainty for a variable <PARAM> is reasonably well-known, it must be provided in the attributes. If it is constant is should be provided in the attribute <PARAM>:uncertainty. If not constant it should be provided in a variable of its own, <PARAM_uncertainty>.. The standard name for this variable is formatted as: "<parameter_standard_name> standard_error" (e.g. TEMP_uncertainty:standard_name = "sea_surface_temperature standard_error")

The attribute <PARAM>:accuracy becomes optional when uncertainty is defined in either the attribute <PARAM>:uncertainty or the variable <PARAM_uncertainty>.

If it is impossible to estimate the overall measurement uncertainty, it is required to define at least the attribute <PARAM>:accuracy with the nominal sensor accuracy.

The attributes <PARAM>:precision and <PARAM:resolution are optional, they contain the sensor precision and resolution if defined.

3.3.6.3 - Example

This example is extracted from the "IMOS Data Streams and their Uncertainties" document (Underwood, 2008).

A temperature measurement may be given as "20.12 degrees Celsius with a 95% confidence of 0.01 degree Celsius". To rephrase this, there are 5 chances in one hundred that the real temperature (the measurand) was outside the range 20.12 C +- 0.01 C.

In a NetCDF file, the uncertainty on this temperature measurement will appear as:

TEMP:uncertainty = 0.01

3.3.7 - Example (see Appendix 1)

The use of all the different parameters discussed in this current chapter such as the data file dimensions, the global attributes, the coordinate variables, the data variables and the quality control variables is given Appendix 1 using sea surface temperature as an example.

4 - IMOS METADATA FORMAT

All IMOS data will be available online through an IMOS/eMII data portal.

Some data users will know exactly what data sets they wish to use and will be able to access those data directly. However, some users will need to search the IMOS data catalogues to find out what data is available. The diversity of IMOS data means that there needs to be an efficient, searchable catalogue of metadata describing the data that is available. The eMII MEST will perform the role of this catalogue.

IMOS metadata requirements comply to international standards and particularly to the Marine Community Profile of ISO19115 (Reed 2008).

MEST metadata records can be generated manually or automatically:

- MEST metadata records can be created manually in xml or using a Metadata entry application, however, this time consuming process requires some knowledge of the ISO standard.
- MEST metadata records can be mapped automatically from netCDF global attributes

When netCDF data files are provided, eMII intend to automate the creation of metadata records.

NetCDF files produced to this IMOS netCDF convention contain all of the metadata required by the Marine Community Profile of ISO19115 and other international standards. eMII MEST records can be generated from netCDF global attributes without futher effort on the part of IMOS facilities / data suppliers.

4.1 - eMII MEST

A link to the eMII MEST (Metadata Entry and Search Tool) can be found online at:

http://imos.org.au/emii_data.html

The url for the eMII MEST is:

http://imosmest.emii.org.au/geonetwork/srv/en/main.home

5 - IMOS FILE NAMING CONVENTION

NetCDF files will be named according to the IMOS NetCDF File Naming Convention (Mancini et. al 2008), see Appendix 2.

The most recent version of the IMOS NetCDF file naming convention can be found online at:

http://www.imos.org.au/reports0.html

6 - REFERENCE TABLES

6.1 - IMOS parameter dictionary

Currently, IMOS parameter names are not strictly standardised. The parameter dictionary seeks to rectify this problem.

Reference Table A lists parameter names, standard names (or long names for non-CF parameters) and units. The list is not exhaustive and will continue to expand as the netCDF convention is implemented. Ultimately, this list will constitute an IMOS data parameter dictionary. Where possible, the standard names used in the IMOS parameter dictionary are taken from the CF standard names, available at:

http://cf-pcmdi.llnl.gov/documents/cf-standard-names/

Additional (non-CF) parameter names are derived from dictionaries that can be found on the web:

- a list of parameter names available on the WOCE website using GF3 codes (WOCE, 2009):

  http://woce.nodc.noaa.gov/woce_v3/wocedata_1/sss/documents/liste_param.htm

- a parameter dictionary available on the OceanSites website (OceanSites, 2008):

  http://www.ifremer.fr/co/etc/oceansites/oceansites-user-manual-parameters.pdf

Non-CF names are marked in the table with the symbol "†".

Non-CF parameters (with no CF 'standard name') should be described using only the attribute 'long name'.

All units defined for the parameters are compliant with Udunits (Unidata Program Centre of the University Corporation for Atmospheric Research, 2008) as implemented by the CF standard. Definitions are available from:

http://www.unidata.ucar.edu/software/udunits

Reference Table A : List of IMOS parameter names, standard names (or long names for Non CF parameters) and units. Non-CF parameters are marked with the symbol "†".

Parameter	CF standard name (or long name for Non CF parameter "†")	Units
AIRT	air_temperature	Celsius
ATMP	air_pressure	Pascal
ATMS	air_pressure_at_sea_level	Pascal
CDIR	direction_of_sea_water_velocity	Degrees clockwise from true North in the direction of the current
† CDOM	concentration_of_coloured_dissolved_organic_matter	ppb
CNDC	sea_water_electrical_conductivity	S m^{-1}
† CPHL	concentration_of_chlorophyll_in_sea_water	mg m^{-3}
CSPD	sea_water_speed	m s^{-1}
DEPTH	depth	m
DEWT	dew_point_temperature	Celsius
DOX2	moles_of_oxygen_per_unit_mass_in_sea_water	mol kg^{-1}
DOXY	mass_concentration_of_oxygen_in_sea_water	kg m^{-3}
DOXY_TEMP	temperature_of_sensor_for_oxygen_in_sea_water	Celsius
DRYT	dry_bulb_temperature	Celsius
DYNHT	dynamic_height	m
EWCT	eastward_sea_water_velocity	m s^{-1}
† FLU2	fluorescence	mg m^{-3}
† HEAT	heat_content	10^{10} J m^{-2}
HEAT_NET	upward_heat_flux_in_air	W m^{-2}
HCSP	sea_water_speed	m s^{-1}
HL	surface_upward_latent_heat_flux	W m^{-2}
HS	surface_upward_sensible_heat_flux	W m^{-2}
ISO<n> [9]	isotherm_depth	m
LATITUDE	latitude	degrees north

[9] ISO<n> = depth of isotherm <n> degrees Celsius, for example, ISO17 = depth of 17 degree Celsius isotherm.

LONGITUDE	longitude	degrees east
LW	surface_downwelling_longwave_flux_in_air	W m^{-2}
LW_NET	surface_net_upward_longwave_flux	W m^{-2}
MASS_NET	upward_mass_flux_of_air	kg m^{-2} s^{-1}
NSCT	northward_sea_water_velocity	m s^{-1}
† NTRI	mole_concentration_of_nitrate_in_sea_water	mole m^{-3}
† OPBS	optical_backscattering_coefficient	
PCO2	surface_partial_pressure_of_carbon_dioxide_in_air	Pascal
† PHOS	moles_of_phosphate_per_unit_mass_in_sea_water	mole kg^{-1}
PRES	sea_water_pressure	dbar
PSAL	sea_water_salinity	$1e^{-3}$
Q	specific_humidity	
RRATE	rainfall_rate	mm s^{-1}
RAIN_AMOUNT	thickness_of_rainfall_amount	m
RELH	relative_humidity	%
† SLCA	mole_concentration_of_silicate_in_sea_water	mole m^{-3}
SRAD	isotropic_shortwave_radiance_in_air	W m^{-1} sr^{-1}
SST	sea_surface_skin_temperature	Celsius
SW	surface_downwelling_shortwave_flux_in_air	W m^{-2}
SW_NET	surface_net_upward_shortwave_flux	W m^{-2}
TAU	magnitude_of_surface_downward_stress	Pascal
TEMP	sea_water_temperature	Celsius
TIME	time	s
†TURB	turbidity	NTU
UCUR	eastward_sea_water_velocity	m s^{-1}
UWND	eastward_wind	m s^{-1}
VAVH	sea_surface_wave_significant_height	m
VAVT	sea_surface_wave_zero_upcrossing_period	s
† VBSC	volumetric_backscatter_coefficient	m^{-1} sr^{-1}
VCUR	northward_sea_water_velocity	m s^{-1}
VDEN	sea_surface_wave_variance_spectral_density	m^2 s

VDIR	sea_surface_wave_from_direction	Degree clockwise from true North
VWND	northward_wind	m s^{-1}
WDIR	wind_to_direction	Degree clockwise from true North
WSPD	wind_speed	m s^{-1}

6.2 - Quality control flag scale

6.2.1 -Introduction

The quality control flags indicate the data quality of the data values in a file, and are assigned after quality control procedures have been performed. These codes are used in the <PARAM_quality_control> (example: Byte TEMP_quality_control(TIME,DEPTH)) variables to describe the quality of each measurement, or in attributes <PARAM>:quality_control_indicator (example: TEMP:quality_control_indicator = 0) to describe the overall quality of the parameter.

6.2.2 -Quality Control Set

The global attribute **quality_control_set** enables the user to define which Quality Control procedure was applied to the dataset. Please see section 3.3.5 for definitions of Quality Control sets.

If your facility is using a different set of quality control codes please supply eMII with the details. If appropriate, we will incorporate your codes into the IMOS convention and create a QC set that meets your needs.

Reference Table B : List of QC procedure flags used in the IMOS project

Set Number	Description
1	IMOS standard set using the IODE flags
2	ARGO quality control procedure
3	BOM (SST and Air-Sea flux) quality control procedure

6.2.3 -SET 1 IMOS standard set using the IODE flags

Reference Table C : IMOS standard set using the IODE flags

Flag Value	Meaning	Description
0	No QC performed	The level at which all data enter the working archive. They have not yet been quality controlled
1	Good data	Top quality data in which no malfunctions have been identified and all real features have been verified during the quality control process
2	Probably good data	Good data in which some features (probably real) are present but these are unconfirmed. Code 2 date are also data in which minor malfunctions may be present but these errors are small and/or can be successfully corrected without seriously affecting the overall quality of the data.
3	Bad data that are potentially correctable	Suspect data in which unusual, and probably erroneous features are observed
4	Bad data	Obviously erroneous values are observed
5	Value changed [10]	Altered by a QC Centre, with original values (before the change) preserved in the history record of the profile
6	Not used	Flag 6 is reserved for future use
7	Not used	Flag 7 is reserved for future use
8	Interpolated value	Indicates that data values are interpolated
9	Missing value	Indicates that the element is missing

[10] eMII discourage the use of this flag. Where data values must be changed (e.g. smoothing of data sets) we strongly prefer that the original data be retained and an additional variable be added to accommodate the interpolated/corrected data values.

6.2.4 -SET 2 ARGO quality control procedure

6.2.4.1 - ARGO measurement flag scale

Reference Table D : ARGO measurement flag scale

Flag Value	Meaning	Real-time comment	Delayed-mode comment
0	No QC was performed	No QC was performed	No QC was performed
1	Good data	All ARGO real-time QC tests passed	The adjusted value is statiscally consistent and a statistical error estimate is supplied
2	Probably good data	Probably good data	Probably good data
3	Bad data that are potentially correctable	Argo QC tests (15, 16 or 17, see Carval et al 2008) failed and all other real-time QC tests passed. These data are not to be used without scientific correction. A flag 3 may be assigned by an operator during additional visual QC for bad data that may be corrected in delayed mode	An adjustment has been applied, but the value may still be bad
4	Bad data	Data have failed one or more of the real-time QC tests, excluding Test 16 (see Carval et al 2008). A flag 4 may be assigned by an operator during additional visual QC for bad data that are not	Bad data. Not adjustable

		correctable	
5	Value changed [11]	Value changed	Value changed
6	Not used	Not used	Not used
7	Not used	Not used	Not used
8	Interpolated value	Interpolated value	Interpolated value
9	Missing value	Missing value	Missing value

6.2.4.2 - ARGO profile quality flags

Argo profile qualities (A to F) are defined as the percentage of levels (N) with good data, where:

- QC flag values of 1, 2, 5 or 8 are GOOD data
- QC flag values of 9 (missing) are NOT USED in the computation
- All other QC flag values are BAD data

The computation should be taken from <PARAM_ADJUSTED_QC> if available and from <PARAM_QC> otherwise (Carval et al 2008).

Reference Table E : ARGO profile quality flags

Flag	Meaning
" " (blank)	No QC performed
A	N = 100%; All profile levels contain good data
B	75% <= N < 100%
C	50% <= N < 75%
D	25% <= N < 50%

[11] eMII discourage the use of this flag. Where data values must be changed we strongly prefer that the original data be retained and an additional variable be added to accommodate the interpolated/corrected data values.

E	0% <= N < 25%
F	N = 0%; No profile levels have good data

Example:

A TEMP profile has 60 levels (3 levels contain missing values)

- 45 levels are flagged as 1
- 5 levels are flagged as 2
- 7 levels are flagged as 4
- 3 levels are flagged as 9 (missing)

Percentage of good levels = ((45+5)/57)*100 = 87.7%

PROFILE_TEMP_QC = "B"

6.2.5 -SET 3 BOM quality control procedure (SST and Air-Sea fluxes)

Reference Table F summarises the different flags used by the Bureau of Meteorology to qualify the quality for different datasets, particularly SST and Air-Sea fluxes (Verein 2008).

Reference Table F : BOM Quality Control procedure flags (SST and Air Sea Fluxes)

Flag	Purpose
B	Value out of bounds
C	Time not sequential
D *	Failed T > Tw > Td test (see Verein 2008)
E *	Failed resultant wind recomputation test
F	Platform velocity unrealistic
G **	Value exceeds (climatological) threshold
H ***	Discontinuity in data
L	Value located over land
T	Time duplicate
U *	Suspect data (statistical)
V *	Spike in data (statistical)
X *	Step in data (statistical)
Z	Value passes all test

Note: * - test is not realized yet, ** - applied for SST, *** - applied for time

6.3 - Cell methods

Cell methods are applied in generating the parameter value for a cell, particularly for raster data sets. This table is extracted from the NetCDF Climate and Forecast (CF) convention version 1.2 (Eaton et al 2008).

In the Units column, u indicates the units of the physical quantity before the method is applied.

Reference Table G : List of different cell methods, derived from the CF convention

Cell method	Units	Description
point	u	The data values are representative of points in space or time (instantaneous). This is the default method for a quantity that is intensive with respect to the specified dimension.
sum	u	The data values are representative of a sum or accumulation over the cell. This is the default method for a quantity that is extensive with respect to the specified dimension
maximum	u	Maximum
median	u	Median
mid_range	u	Average of the maximum and minimum
minimum	u	Minimum
mean	u	Mean (average value)
mode	u	Mode (most common value)
standard_deviation	u	Standard deviation
variance	u^2	Variance

7 - REFERENCES

Bainbridge, S. 2008. *Data Standards Framework for the IMOS instrument Data.* AODCJF Internal Report.

Carval, T., Keeley, B., Takatsuki, Y, Yoshida, T., Lock, S., Schmid, C., Goldsmith, R., Wong, A., McCreadie, R., Thresher, A and Tran, A. 2008. *Argo Data Management User's Manual Version 2.1*. IFREMER.

Convention for the standardisation of NetCDF Files. 1995. Sponsored by the "Cooperative Ocean/Atmosphere Research Data Service, a NOAA/university cooperative for the sharing and distribution of global atmospheric and oceanographic research data sets. http://ferret.wrc.noaa.gov/noaa_coop/coop_cdf_profile.html Accessed December 2008.

Eaton, B., Gregory, J., Drach, B., Taylor, K, Hnakin, S., Caron, J., Signell, R., Bentley, P. and Rappa, G. 2009. *NetCDF Climate and Forecast (CF) Metadata Conventions v1.4* http://cf-pcmdi.llnl.gov/ Accessed March 2009.

International Organization for Standardization. 2009. *Numeric represenatation of Dates and Time.* http://www.iso.org/iso/support/faqs/faqs_widely_used_standards/widely_used_standards_other/date_and_time_format.htm Accessed 27 Jan 2009

Mancini, S., Tattersall, K., and Proctor, R. 2008. *IMOS NetCDF File Naming Convention v1.1* http://imos.org.au/reports0.html Accessed 31 January 2009.

OceanSITES. 2007. *Taking the Pulse of the Global Ocean* http://www.oceansites.org Accessed 27 January 2009.

OceanSites 2008. *OceanSites Parameters Table*. http://www.ifremer.fr/co/etc/oceansites/oceansites-user-manual-parameters.pdf Accessed 27 January 2009.

Olsen, L.M, G. Major, K. Shein, J. Scialdone, R. Vogel, S. Leicester, H. Weir, S. Ritz, T. Stevens, M. Meaux,c. Salomon, R. Bilodeau, M. Holland, T. Northcutt, R.A. Restrepo, 2007. NASA/Global Change Master Directory (GCMD) Earth Science Keywords version 6.0.0.0.0. http://gcmd.nasa.gov/Resources/valids/archives/keyword_list.html Accessed 18 Mar 2009.

Reed, G. 2008. *Marine Community Profile of ISO 19115 Version 1.4*. Australian Ocean Data Centre Joint Facility

Rew, R., Davis, G., Emmersson, S. and Davies, H. 2008. *UniData NetCDF User's Guide* http://www.unidata.ucar.edu/ Accessed 20 Dec 2008.

SeaDataNet 2009. *SeaDataNet measurand qualifier flags : list key L201.* http://seadatanet.maris2.nl/v_bodc_vocab/welcome.aspx Accessed 27 Jan 2009.

Time and Date AS. 2009. *Time Zone in Hobart* http://www.timeanddate.com/worldclock/timezone.html?n=396. Accessed 27 Jan 2009.

Underwood, M. 2008. *IMOS Data streams and their Uncertainties v 3.1* http://imos.org.au/reports0.html Accessed 15 December 2008.

Unidata Program Centre of the University Corporation for Atmospheric Research. 2008. *Writing NetCDF Files: Best Practices* http://www.unidata.ucar.edu/software/netcdf/docs/BestPractices.html Accessed 15 December 2008.

Unidata Program Centre of the University Corporation for Atmospheric Research. 2008. *UDUNITS Software Package*. http://www.unidata.ucar.edu/software/udunits/ Accessed 15 December 2008..

Verein, R. 2008. *Quality Control procedure for automated processing of IMOS ship and mooring observations (Facilities 2c, 2d and 3).* CAWCR. Australian Bureau of Meterology.

Wikipedia contributors. 2008. *Wikipedia, The Free Encyclopedia : ISO 8601* http://en.wikipedia.org/wiki/ISO_8601. Accessed Jan 20 2009.

World Ocean Circulation Experiment 2009. *WOCE Parameter Lists: Basic Parameters & Full List of Parameters with extended-GF3 codes.* http://woce.nodc.noaa.gov/woce_v3/wocedata_1/sss/documents/liste_param.htm Accessed 27 January 2009.

APPENDIX 1: EXAMPLE NETCDF FILE

This is an example IMOS formatted NetCDF file for SOOP XBT (expendable bathythermograph) data.

```
netcdf IMOS_SOOP-XBT_T_20071120T150000Z_QLD12_FV01 {
dimensions:
        TIME = UNLIMITED ; // (11465 currently)
        LONGITUDE = 80 ;
        LATITUDE = 80 ;
        DEPTH = 30 ;
variables:
        double TIME(TIME) ;
                TIME:long_name = "time" ;
                TIME:units = "days since 1950-01-01T00:00:00Z" ;
                TIME:standard_name = "time" ;
                TIME:_FillValue = 99999 ;
                TIME:valid_min = 0 ;
                TIME:valid_max = 54750 ;
                TIME:comment = "Relative julian days with decimal part as parts of the day" ;
                TIME:quality_control_set = 1 ;
                TIME:quality_control_indicator = 1 ;
                TIME:uncertainty = 0.0003 ;
                TIME:axis = "T" ;
                TIME:local_time_zone = 10 ;
                TIME:ancillary_variables = "TIME_quality_control"
        byte TIME_quality_control(TIME) ;
                TIME_quality_control:standard_name = "time status_flag" ;
                TIME_quality_control:long_name = "quality control flag for time"
                TIME_quality_control:quality_control_convention = "IMOS standard set using IODE flags";
                TIME_quality_control:quality_control_set = 1
                TIME_quality_control:valid_min = 0 ;
                TIME_quality_control:valid_max = 9 ;
                TIME_quality_control:_FillValue = -10 ;
                TIME_quality_control:flag_values = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 ;
                TIME_quality_control:flag_meanings = "no_qc_performed good_data probably_good_data
                bad_data_that_are_potentially_correctable bad_data value_changed not_used not_used interpolated_value
                missing_value";
        float LONGITUDE(LONGITUDE) ;
                LONGITUDE:long_name = "longitude of each location" ;
                LONGITUDE:units = "degrees_east" ;
                LONGITUDE:standard_name = "longitude" ;
                LONGITUDE:_FillValue = 99999 ;
                LONGITUDE:valid_min = -180 ;
                LONGITUDE:valid_max = 180 ;
                LONGITUDE:quality_control_set = 1 ;
                LONGITUDE:quality_control_indicator = 1 ;
                LONGITUDE:uncertainty = 0.0001 ;
```

LONGITUDE:axis = "X" ;
LONGITUDE:reference_datum = "geographical coordinates, WGS84 projection" ;
LONGITUDE:ancillary_variables = "LONGITUDE_quality_control"
byte LONGITUDE_quality_control(LONGITUDE) ;
LONGITUDE_quality_control:standard_name = "longitude status_flag" ;
LONGITUDE_quality_control:long_name = "quality control flag for longitude"
LONGITUDE_quality_control:quality_control_convention = "IMOS standard set using IODE flags";
LONGITUDE_quality_control:quality_control_set = 1 ;
LONGITUDE_quality_control:valid_min = 0 ;
LONGITUDE_quality_control:valid_max = 9 ;
LONGITUDE_quality_control:_FillValue = -10 ;
LONGITUDE_quality_control:flag_values = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 ;
LONGITUDE_quality_control:flag_meanings = "no_qc_performed good_data probably_good_data bad_data_that_are_potentially_correctable bad_data value_changed not_used not_used interpolated_value missing_value";
float LATITUDE(LATITUDE) ;
LATITUDE:long_name = "latitude of each location" ;
LATITUDE:units = "degrees_north" ;
LATITUDE:standard_name = "latitude" ;
LONGITUDE:_FillValue = 99999 ;
LONGITUDE:valid_min = -90 ;
LONGITUDE:valid_max = 90 ;
LONGITUDE:quality_control_set = 1 ;
LONGITUDE:quality_control_indicator = 1 ;
LONGITUDE:uncertainty = 0.0001 ;
LONGITUDE:axis = "Y" ;
LONGITUDE:reference_datum = "geographical coordinates, WGS84 projection" ;
LATITUDE:ancillary_variables = "LATITUDE_quality_control"
byte LATITUDE_quality_control(LATITUDE) ;
LATITUDE_quality_control:standard_name = "latitude status_flag" ;
LATITUDE_quality_control:long_name = "quality control flag for latitude"
LATITUDE_quality_control:quality_control_convention = "IMOS standard set using IODE flags";
LATITUDE_quality_control:quality_control_set = 1 ;
LATITUDE_quality_control:valid_min = 0 ;
LATITUDE_quality_control:valid_max = 9 ;
LATITUDE_quality_control:_FillValue = -10 ;
LATITUDE_quality_control:flag_values = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 ;
LATITUDE_quality_control:flag_meanings = "no_qc_performed good_data probably_good_data bad_data_that_are_potentially_correctable bad_data value_changed not_used not_used interpolated_value missing_value";
float DEPTH(DEPTH) ;
DEPTH:long_name = "depth" ;
DEPTH:units = "metres" ;
DEPTH:standard_name = "depth" ;
DEPTH:_FillValue = 99999 ;
DEPTH:valid_min = 0 ;
DEPTH:valid_max = 12000 ;
DEPTH:positive = "down";
DEPTH:quality_control_set = 1 ;
DEPTH:quality_control_indicator = 1 ;

DEPTH:uncertainty = 0.01 ;
DEPTH:axis = "Z" ;
DEPTH:reference_datum = "Mean Sea Level (MSL)" ;
DEPTH:ancillary_variables = "DEPTH_quality_control"
byte DEPTH_quality_control(DEPTH) ;
DEPTH_quality_control:standard_name = "depth status_flag" ;
DEPTH_quality_control:long_name = "quality control flag for depth"
DEPTH_quality_control:quality_control_convention = "IMOS standard set using IODE flags";
DEPTH_quality_control:quality_control_set = 1 ;
DEPTH_quality_control:valid_min = 0 ;
DEPTH_quality_control:valid_max = 9 ;
DEPTH_quality_control:_FillValue = -10 ;
DEPTH_quality_control:flag_values = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 ;
DEPTH_quality_control:flag_meanings = "no_qc_performed good_data probably_good_data bad_data_that_are_potentially_correctable bad_data value_changed not_used not_used interpolated_value missing_value";
float TEMP(TIME, DEPTH, LATITUDE, LONGITUDE) ;
TEMP:long_name = "Surface Temperature in degrees C" ;
TEMP:units = "Celsius" ;
TEMP:standard_name = "sea_water_temperature" ;
TEMP:_FillValue = 99999 ;
TEMP:quality_control_set = 1 ;
TEMP:valid_min = -2.0 ;
TEMP:valid_max = 40 ;
TEMP:ancillary_variables = "TEMP_quality_control";
TEMP:uncertainty = 0.001 ;
byte TEMP_quality_control(TIME, DEPTH, LATITUDE, LONGITUDE) ;
TEMP_quality_control:standard_name = "sea_water_temperature status_flag" ;
TEMP_quality_control:long_name = "quality control flag for sea_water_temperature" ;
TEMP_quality_control:quality_control_convention = "IMOS standard set using IODE flags";
TEMP_quality_control:quality_control_set = 1 ;
TEMP_quality_control:valid_min = 0 ;
TEMP_quality_control:valid_max = 9 ;
TEMP_quality_control:_FillValue = -10 ;
TEMP_quality_control:flag_values = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 ;
TEMP_quality_control:flag_meanings = "no_qc_performed good_data probably_good_data bad_data_that_are_potentially_correctable bad_data value_changed not_used not_used interpolated_value missing_value";

// global attributes:
:project = "Integrated Marine Observing System" ;
:title = " IMOS_SOOP-XBT_T_20071120T150000Z_QLD12_FV01 " ;
:institution = "SOOP" ;
:conventions = "IMOS version 1.2" ;
:date_created = "2007-12-10T12 :00 :00Z" ;
:source = "Ship observation" ;
:keywords = "Oceans>Ocean Temperature>Water Temperature" ;
:data_centre_email = "info@emii.org.au" ;
:principal_investigator = "John Doe"
:geospatial_lat_min = -35.0 ;

:geospatial_lat_max = -36.0 ;
:geospatial_lon_min = 151 ;
:geospatial_lon_max = 152 ;
:geospatial_vertical_min = 0 ;
:geospatial_vertical_max = 300 ;
:time_coverage_start = "2007-11-20T15:00:00Z" ;
:time_coverage_end = "2008-11-11T14:00:00Z" ;
:data_centre = "eMarine Information Infrastructure" ;
:netcdf_version = 3.5 ;
:references = "http://www.imos.org.au" ;
:abstract = " Temperature data from the TOGA/WOCE transect PX34 across the Tasman Sea has been collected since January 1991 and are ongoing. The transect is repeated approximately 4 times a year, with profiles obtained approximately every 10-50 Km. The data are obtained from XBTs (expendable bathythermographs) deployed via merchant vessels, and are managed by the Joint Australian Facility for Ocean Observing Systems (JAFOOS), a collaborative venture between CSIRO Marine Research and the Bureau of Meteorology Research Centre (BMRC). This NetCDF file was created using The IMOS netCDF file naming convention version 1.2 and the IMOS netCDF user's manual version 1.1." ;
:citation = "IMOS, 2009, *TOGA/WOCE transect PX34 XBT data : November 2007 to November 2008*, www.emii.org.au" ;

//Data

TIME : 21142.50, 21142.75, 21143, 21143.25, 21143.50, 21143.75, ….

TIME_quality_control :1, 1, 1, 1, 1, 1, 1 ....

LATITUDE : -35.1233, -35.1334, -35.1445.,-35.2551, -35.3610, -35.4520, …..

LATITUDE_quality_control : 1, 1, 1, 1, 1, 1, 1 ….

LONGITUDE : 150.1100, 150.2110, 150.3510, 150.3610, 150.4015, 150.4512, ….

LONGITUDE_quality_control1, 1, 1, 1, 1, 1, 1 ….

DEPTH : 0.25, 0.50, 0.75, 1.00, 1.25, 1.50, ….

DEPTH_quality_control : 1, 1, 1, 1, 1, 1, 1 ….

TEMP : 15.12, 16.25, 18.56, 20.45, 25.46, 18.25, …..

TEMP_quality_control :1, 2, 2, 2, 1, 1, 1 ….

}

APPENDIX 2: IMOS NETCDF FILENAMING CONVENTION V 1.3

IMOS NETCDF FILE NAMING CONVENTION

Version 1.3
May 8th, 2009

Table of contents

PREFACE TO VERSION 1.3 1

PREFACE TO VERSION 1.2 1

PREFACE TO VERSION 1.1 1

1 - FILE NAMING CONVENTION 3

1.1 - DATA FILE NAMING CONVENTION 3

1.1.1 - Reference Table 1: Facility Codes 6

1.1.2 - Reference Table 2: Data Codes 7

1.1.3 Reference Table 3: Platform Codes 9

1.1.4 Reference Table 4: File Version Codes 14

1.2 - EXAMPLES 15

1.2.1 - Facility 1: ARGO 15

1.2.2 - Facility 2: SOOP 15

1.2.3 - Facility 3: SOTS 16

1.2.4 - Facility 4: ANFOG 17

1.2.5 - Facility 5: AUV 17

1.2.6 - Facility 6: ANMN 17

1.2.7 - Facility 7: ACORN 19

1.2.8 - Facility 8: AATAMS 19

1.2.9 - Facility 9: FAIMMS 19

1.2.10 - Facility 11: SRS 19

PREFACE to version 1.3

The IMOS file naming discussion document has now been implemented as the IMOS NetCDF file naming convention.

Version 1.3 of the IMOS file naming convention has incorporated an extra **data code**: 'P' for pressure of sea water. **Data code** 'F' has been defined more clearly.

A number of facilities have provided **platform codes** which are now included in Reference Table 3.

PREFACE to version 1.2

Version 1.2 of the IMOS file naming convention incorporates a small number of additional **data codes** requested by users after the release of v 1.1 :

F = Fluxes
K = Chemistry
R = Raw Data

Some facilities have provided us with extended lists of **platform codes**. The platform code table (Reference Table 3) has been updated to incorporate these codes.

If platform codes for your facility are not listed in this document, please provide the code table to eMII.

PREFACE to version 1.1

Thank you to everyone for your responses to our original file naming discussion document (1.0). The input we've received has been valuable and thought-provoking and we hope has lead to a better and more useful convention, outlined here in discussion document 1.1.

Summary of IMOS facility reponses to discussion document version 1.0 :

- File names should be human-readable with less codes
- Platform codes need to be more flexible

- Data versions should be included: eg Level 0 = raw, Level 1 = …
- Product codes are necessary for creation of unique file names in some facilities eg. 14 day average, 2m gridded data
- Time of file creation and other facility specific file reference codes should be integrated (though perhaps optional)
- End times for data could be included in file names
- Long file names are acceptable

Summary of changes made to document in producing version 1.1 :

- **'Facility codes' were changed to facility acronyms (sub-facilities when necessary).** Some suggested using whole words, eg. 'Moorings', but we decided against this as it could apply to SOTS moorings, ANMN moorings, NRS moorings, Acoustic listening moorings, AATAMS tag receiver moorings or Qld sensor network moorings. Acronyms are more clear for users familiar with IMOS data sets.

- **'Platform codes' are more flexible**, with no limit to the number of characters that can be used.

- **5 levels of data versioning have been defined**. Data versions are identified by the codes FV00 to FV04 as described in this document.

- Optional **'Product codes' have been incorporated into file names.**

- An optional **'Time of creation' field has been incorporated in file names.**

- Optional **'End time' for data has been incorporated into file names.**

In addition :

- File names can be up to 255 characters long
- Date / time format complies with ISO 8601. eMII strongly prefer that all date / time fields are in UTC but have provided guidelines for local time if required.

As in version 1.0, we have provided example file names for each facility.

Please provide eMII with feedback on this discussion document if you believe that these suggestions will not work for your facility.

1 - FILE NAMING CONVENTION

For many data types, **IMOS** uses the netCDF (network Common Data Form) system, a set of software libraries and machine-independent data formats that support the creation, access, and sharing of array-oriented scientific data. [1]

The main purpose of this document is to specify the format of filenames that will be used to distribute **IMOS** data in netCDF format.

IMOS netCDF file naming conventions are based on those prescribed by the **OceanSITES** User's Manual, version 1.1. The **OceanSITES** program is a global network of open-ocean sustained time series reference stations that have been implemented by an international partnership of researchers. More information about this project is available at **http://www.oceansites.org**.

1.1 - Data file naming convention

The file name extension of each **netCDF file** must be **".nc".**

Filenames can be up to 255 characters in length and are composed of up to 10 fields separated by '_' (underscore) characters.

Characters which can be used within fields are letters (A to Z) and whole numbers (0 to 9). The hyphen character (-) may also be used within fields.

The NetCDF file name format is:

IMOS_<Facility-Code>_<Data-Code>_<Start-date>_<Platform-Code>_FV<File-Version>_

<Product-Type>_END-<End-date>_C-<Creation_date>_<PARTX>.nc

[1] http://www.unidata.ucar.edu.au/software/netcdf/

The first 6 fields are mandatory and must conform to the following content guidelines:

1. IMOS: Name of the project [2]

2. <Facility-Code> : code representing a facility (and a sub-facility if applicable) (see 1.1.1 - Reference Table 1: Facility Codes).

3. <Data-Code>: list of data codes from reference table 2. The data codes are descriptors of the primary parameters measured. Data codes do not list secondary parameters (see 1.1.2 - Reference Table 2: Data Codes).

4. <Start-date>: start date and time of the measurement, not of file creation. The date and time are formatted to international standard ISO8601. eMII requests that the time be in UTC.

   Date format is: YYYYMMDDTHHMMSSZ where T is the delimiter between date and time and Z indicates that time is in UTC. If time is not in UTC, local time must be shown as hours plus or minus from the longitudinal meridian. Z is not appended when local time is used. Examples of the time format are below.

   - 20081024T080000Z (UTC)
   - 20081024T180000+10 (Local)
   - 20081024T020000-06 (Local)

5. <Platform-Code>: code representing the platform [3] (see 0 Reference Table 3: Platform Codes).

6. <File-Version>: value representing the version of the file (see 1.1.4 Reference Table 4: File Version Codes).

---

[2] Any data produced by the IMOS project should be instantly identifiable as 'IMOS' data

[3] **Notes on platform codes:** The platform codes for data file naming conventions (reference table 2) are *under development.*

Platform codes must be unique within an **IMOS** facility and must apply to either one particular unit of equipment or to one particular location.

To finalise platform codes, eMII needs more information about the formats of different 'platform' codes that are currently used by each facility. eMII anticipate that the codes already in use within many facilities will be suitable.

Characters which can be used are capital letters (A to Z) and whole numbers (0 to 9). The hyphen character (-) may also be used.

The following 4 fields are optional:

7. <Product-Type>: This code will give information about the product included in the dataset.

8. <End-date>: end date and time of the measurement. The data format is the same as the start date. The code should be preceded by the following four characters END-. An example of the format of the end date should be: “END-20081112T231255Z”

9. <Creation-date>: creation date and time of the file. The data format is the same as the start and end date. The code should be preceded by the two characters C-. An example of the format of the creation date should be “C-20081112T231255Z”.

10. <_PARTX>: when an IMOS data file size becomes excessive (eg: >100Mb), it can be split in smaller parts: PART1, PART2,….,PARTN

1.1.1 - Reference Table 1: Facility Codes

Facility	Sub-Facility (if applicable)	Code
ARGO		ARGO
SOOP	Multi-disciplinary Underway Network XBT	SOOP-XBT
	Multi-disciplinary Underway Network CO2	SOOP-CO2
	Multi-disciplinary Underway Network CPR	SOOP-CPR
	Sensors on Tropical Research Vessels	SOOP-TRV
	Sea Surface Temperature Sensors	SOOP-SST
	Research Vessel Real Time Air-Sea Fluxes	SOOP-ASF
SOTS		SOTS
ANFOG		ANFOG
AUV		AUV
ANMN	Queensland and Northern Australia	ANMN-QLD
	New South Wales	ANMN-NSW
	Southern Australia	ANMN-SA
	Western Australia	ANMN-WA
	Acoustic Observatories	ANMN-AO
	National Reference Stations Analysis and Coordination	ANMN-NRS
	Satellite Ocean Colour Calibration/Validation	ANMN-SOC
ACORN		ACORN
AATAMS		AATAMS
FAIMMS		FAIMMS
SRS	Australian Satellite SST L2P Products	SRS-A
	Australian Ocean Distributed Archive and Access Centre	SRS-B
	Upgrade Hobart Ground Station	SRS-C
	Upgrade Townsville Ground Station	SRS-D

1.1.2 - Reference Table 2: Data Codes

Data Code	Meaning
A	Acoustic measurements
B	Biology (plankton, fluorescence)
C	Conductivity (electrical conductivity of sea water)
E	Engineering or technical parameters
F	Fluxes (e.g. radiation, latent heat, sensible heat)
G	Gas (measurement and fluxes)
I	Images
K	Chemistry (nutrients, trace metals)
M	Meteorological parameters (e.g. wind, air pressure, air temperature)
O	Oxygen concentration (in sea water)
P	Pressure
R	Raw data
S	Salinity (of sea water)
T	Temperature (of sea water)
U	Turbidity (of sea water)
V	Velocity (of sea water)
W	Wave parameters (significant wave height,

	peak period, peak direction …)

1.1.3 Reference Table 3: Platform Codes

	Facility	Sub-facility	Platform Codes	Platform Description	Code Description
1	ARGO		Argo convention		No change to Argo data/file name formats
2	SOOP	2a(i) XBT	PX34	Sydney to Wellington (CSIRO line)	XBT line identifier
			IX28	Dumont D'Urville to Hobart (CSIRO line)	
			PX30-31	Brisbane to Noumea/ Suva/ Lautoka (CSIRO line)	
			IX15-21	Melbourne/ Fremantle to Mauritius/ Durban (SCRIPPS line)	
			IX1	Fremantle to Sunda Straits (BOM line)	
			IX12	Fremantle to Red Sea (BOM line)	
			PX2	Flores Sea to Torres Strait (BOM line)	
			IX22-PX11	Shark Bay to Japan (BOM line)	
		2a(ii) CO2	Unknown		Ship call signs, or 'system' identifiers eg. CO2 on Southern Surveyor = SSCO2
		2a(iii) CPR	Unknown		ID for CPR deployed, 2-6 letter/number codes eg. Unit 1 = U001 *or* CPR line if more appropriate
		2b Trop Res	RVCF	Cape Ferguson	Ship code : Call sign/AIMS code
			RVS	Solander	
		2c SST	VLHJ	RV Southern Surveyor	Ship call sign *or* WMO code
			VHW5167	MV Seaflyte (Rottnest Island Ferry)	
			FHZI	RV L'Astrolabe	
			VNAA	RSV Aurora Australis	
			VLST	MV Spirit of Tasmania I	
			VNSZ	MV Spirit of Tasmania II	
			VJQ7467	MV Fantasea (Whitsundays Ferry)	

			C6FS9	MV Stadacona	
			VNAH	MV Portland	
			MNPJ3	MV Pacific Sun	
			VROB	MV Kiribati Chief	
			VNVR	MV Iron Yandi	
			V2BJ5	MV ANL Yarunga	
		2d A-S Flux		As for 2c SST Platform Codes	Ship call sign *or* WMO code
3	SOTS		SAZOTS	Sediment traps	
			PULSE	Ocean observations	For 2008-2009 deployment : PULSEH, PULSEL
			SOFS	Meteorological mooring	
			PROF	Argo profiles	
			GLID	Glider	
4	ANFOG		SG151	Seaglider	Manufacturer unit number
			SG152	Seaglider	
			SG153	Seaglider	
			SG154	Seaglider	
			SG155	Seaglider	
			SL104	Slocum	
			SL106	Slocum	
			SL109	Slocum	
5	AUV		SIRIUS		If other AUVs are recruited to the facility, they will need codes
6	ANMN	6a QLD	GBROTE	One Tree East	AIMS mooring codes
			GBRHIS	Heron Island South	
			GBRHIN	Heron Island North	
			GBRELR	Elusive Reef	
			GBRCCH	Capricorn Channel	
			GBRMYR	Myrmidon	
			GBRPPS	Palm Passage	
			GBRLSH	Lizard Shelf	
			GBRLSL	Lizard Slope	
		6b NSW	NSCH10	Coffs Harbour 100m	NSW-IMOS mooring codes
			NSCH07	Coffs Harbour 70m	
			NSSY10	Sydney 100m	
			NSSY14	Sydney 140m	
			NSPH10	Port Hacking 100m	
			NSPH05	Port Hacking 50m	
			NSJB07	Jervis Bay	
			NSED07	Eden	
		6c SA	SAM1DS	M1 Deep Slope	SAIMOS mooring codes
			SAM2CP	M2 Cabbage Patch	

			SAM5CY	M4 Canyons	
			SAM5CB	M5 Coffin Bay	
			SAM6IS	M6 Investigator Strait	
		6d WA	WATR05	Two Rocks 50	WAIMOS mooring codes
			WATR10	Two Rocks 100	
			WATR15	Two Rocks 150	
			WATR20	Two Rocks 200 (BGC)	
			WATR50	Two Rocks 500	
			WACA20	Canyon 200m Head (BGC)	
			WACANO	Canyon 500m North	
			WACASO	Canyon 500m South	
		6e Acoustic	PAPCA1	Perth Canyon, WA 1	Acoustic mooring site codes
			PAPCA2	Perth Canyon, WA 2	
			PAPCA3	Perth Canyon, WA 3	
			PAPCA4	Perth Canyon, WA 4	
			PAPOR1	Portland, VIC 1	
			PAPOR2	Portland, VIC 2	
			PAPOR3	Portland, VIC 3	
			PAPOR4	Portland, VIC 4	
			PASYD1	Sydney, NSW 1	
			PASYD2	Sydney, NSW 2	
			PASYD3	Sydney, NSW 3	
			PASYD4	Sydney, NSW 4	
		6f NRS	NRSYON	Yongala, QLD	NRS codes
			NRSDAR	Darwin, NT	
			NRSROT	Rottnest, WA	
			NRSMAI	Maria Island, TAS	
			NRSKAI	Kangaroo Island, SA	
			NRSESP	Esperance, WA	
			NRSNIN	Ningaloo, WA	
			MRSMOR	Moreton Bay, QLD	
			NRSPHB	Port Hacking, NSW	
		6g SOOC	CRSLUC	Lucinda Jetty, QLD	Colour mooring code
7	ACORN		CBG	Capricorn Bunker Group	ACORN codes
			TAN	CBG Tannum Sands	
			LEI	CBG Lady Elliot Island	
			SAG	South Australia Gulf	
			CSP	SAG Cape Spencer	
			CWI	SAG Cape Wiles	
			BONC	Bonnie Coast	
			NOCR	BONC Noora Creena	
			CPDG	BONC Cape Douglas	
			COF	Coffs Harbour	
			RRK	COF Red Rock	

			NNB	COF North Nambucca	
			PCY	Perth Canyon	
			LEB	PCY Leighton Beach	
			GUI	PCY Guilderton	
			TURQ	Turquoise Coast	
			SBRD	TURQ Seabird	
			CRVT	TURQ Cervantes	
8	AATAMS		SYD1	Sydney line (1-30)	Location and receiver position e.g. SYD1 = Sydney line position 1, SYD30 = Sydney line position 30.
			PER1	Perth line (1-30)	
			NRETAN1	Ningaloo Reef Ecological Tracking Array North line (1-7)	
			NRETAC1	NRETA Central line (1-7)	
			NRETAS1	NRETA South line (1-18)	
			MAL1	Mallacoota line (1-30)	
			PORT1	Portland line (1-30)	
			COF1	Coffs Harbour line (1-30)	
9	FAIMMS		HIRP1	Heron Island Relay Pole 1	AIMS sensor network codes eg. Heron Island Relay Pole 1 = HIRP1.
			HIRP2	Heron Island Relay Pole 2	
			HIRP3	Heron Island Relay Pole 3	
			HIRP4	Heron Island Relay Pole 4	
			HIRP5	Heron Island Relay Pole 5	
			HIRP6	Heron Island Relay Pole 6	
			HISF1	Heron Island Sensor Float 1	
			HISF2	Heron Island Sensor Float 2	
			HISF3	Heron Island Sensor Float 3	
			HISF4	Heron Island Sensor Float 4	
			HISF5	Heron Island Sensor Float 5	
			HIWS	Heron Island Weather Station	
			HIBSE	Heron Island Base Station	
			OTIRP1	One Tree Island Relay Pole 1	
			OTIRP2	One Tree Island Relay Pole 2	
			OTIRP3	One Tree Island Relay Pole 3	
			OTIWS	One Tree Island Weather Station	
			OTIBSE	One Tree Island Base Station	

11	SRS		Unknown		Data products in netCDF format may need defining 'codes', eg. SSTL2P. These codes may necessarily be quite complex.

1.1.4 Reference Table 4: File Version Codes

The File Version code will enable a file creator to specify the processing version of the file. The different data levels listed below were derived from a discussion paper "Data Standards Framework for the IMOS Instrument Data" prepared by Scott Bainbridge (AIMS) for the AODCJF [4].

File Version	Definition	Description
FV00	Level 0 – Raw data	Raw data is defined as unprocessed data and data products that have not undergone quality control. The data may be in engineering units or physical units, time and locations details can be in relative units and values can be pre-calibration measurements. Level 0 data is not suitable for public access within IMOS.
FV01	Level 1 – Quality Controlled data	Quality controlled data have passed quality assurance procedures such as routine estimation of timing and sensor calibration or visual inspection and removal of obvious errors. The data are in physical units using standard SI metric units with calibration and other routine pre-processing applied, all time and location values are in absolute coordinates to agreed to standards and datum, metadata exists for the data or for the higher level dataset that the data belongs to. This is the standard IMOS data level and is what should be made available to eMII and to the IMOS community.
FV02	Level 2 – Derived Products	Derived products require scientific and technical interpretation. Normally these will be defined by the community that collects or utilises the data.
FV03	Level 3 – Interpreted Products	These products require researcher driven analysis and interpretation, model based interpretation using other data and / or strong prior assumptions.
FV04	Level 4 – Knowledge Products	These products require researcher driven scientific interpretation and multidisciplinary data integration and include model-base interpretation using other data and/or strong prior assumptions.

[4] http://www.aodc.gov.au/

1.2 - Examples

Example data file names for each **IMOS** facility can be found in this section. These examples are suggestions only.

Please provide eMII with feedback on this discussion document if you believe that these suggestions will not work for your facility.

1.2.1 -Facility 1: ARGO

eMII intend to use the internationally accepted Argo netCDF conventions for GDAC data file naming, ie:

<FloatID>_prof.nc, <FloatID>_traj.nc, <FloatID>_meta.nc, <FloatID>_tech.nc

1.2.2 -Facility 2: SOOP

2a Multidisciplinary Underway Network

XBT

IMOS_SOOP-XBT_T_20080501T100000Z_PX-02_FV01.nc

This file would contain quality controlled Temperature data starting from the 1st May 2008 at 10:00 UTC and collected along XBT line PX-02 by the XBT group in the **IMOS** SOOP Multidisciplinary Underway Network sub-facility.

CO2

IMOS_SOOP-CO2_GST_20080901T120000Z_SSCO2_FV01.nc

This file would contain quality controlled Gas, Salinity and Temperature data starting from the 1st September 2008 at 12:00 UTC and collected with the CO2 system (and associated underway systems) on the Southern Surveyor by the CO2 group in the **IMOS** SOOP Multidisciplinary Underway Network sub-facility.

CPR

IMOS_SOOP-CPR_B_20080901T120000Z_U001_FV01.nc

This file would contain quality controlled Biological data starting from the 1st September 2008 at 12:00 UTC collected with CPR Unit 1 by the CPR group in the **IMOS** SOOP Multidisciplinary Underway Network sub-facility.

2b Sensors on Tropical Research Vessels

IMOS_SOOP-TRV_BTS_20081011T083000Z_RVCF_FV01.nc

This file would contain quality controlled Biological, Temperature and Salinity data starting from the 11th October 2008 at 08:30 UTC collected on RV Cape Ferguson by the **IMOS** SOOP Sensors on Tropical Research Vessels sub-facility.

2c SST

IMOS_SOOP-SST_T_20081030T122500Z_VHW5167_FV00.nc

This file would contain raw Temperature data starting from the 30th of October 2008 at 12:25 UTC, collected from the Rottnest Island Ferry (call sign VHW5167) by the **IMOS** SOOP SST sub-facility.

2d Air-Sea Flux

IMOS_SOOP-ASF_MT_20080204T100000Z_VLHJ_FV01.nc

This file would contain quality controlled Meteorological and Temperature data starting from the 4th of February 2008 at 10:00 UTC, collected from the Southern Surveyor (call sign VLHJ) by the **IMOS** SOOP Air-Sea Flux sub-facility.

1.2.3 -Facility 3: SOTS

IMOS_SOTS_E_20081011T083000Z_PULSEH_FV00.nc

This file would contain raw Engineering data starting from the 11th October 2008 at 08:30 UTC collected by the Heavy Pulse platform of the **IMOS** SOTS facility.

1.2.4 -Facility 4: ANFOG

IMOS_ANFOG_TS_20081011T083000Z_SG154_FV01.nc

This file would contain quality controlled Temperature and Salinity data starting from the 11th October 2008 at 08:30 UTC collected by Seaglider Unit 154 of the **IMOS** ANFOG facility.

1.2.5 -Facility 5: AUV

IMOS_AUV_TS_20080812T122500Z_SIRIUS_FV00.nc

This file would contain raw Temperature and Salinity data starting from the 12th August 2008 at 12:25 UTC collected by AUV Sirius of the **IMOS** AUV facility.

1.2.6 -Facility 6: ANMN

6a Qld and Northern Aust

IMOS_ANMN-QLD_VT_20080801T000000Z_GBRMYR_FV01.nc

This file would contain quality controlled Current Velocity and Temperature data starting from the 1st August 2008 at 00:00 UTC and collected at the Myrmidon mooring site by the **IMOS** ANMN Queensland and Northern Australia sub-facility.

6b NSW

IMOS_ANMN-NSW_VT_20080801T000000Z_NSJB07_FV01.nc

This file would contain quality controlled Current Velocity and Temperature data starting from the 1st August 2008 at 00:00 UTC and collected at the Jervis Bay mooring site by the **IMOS** ANMN NSW sub-facility.

6c SA

IMOS_ANMN-SA_VT_20080801T000000Z_SAM1DS_FV01.nc

This file would contain quality controlled Current Velocity and Temperature data starting from the 1st August 2008 at 00:00 UTC and collected at the M1 Deep Slope mooring site by the **IMOS** ANMN SA sub-facility.

6d WA

IMOS_ANMN-WA_VT_20080801T000000Z_WATR05_FV01.nc

This file would contain quality controlled Current Velocity and Temperature data starting from the 1st August 2008 at 00:00 UTC and collected at the Two Rocks 50m mooring site by the **IMOS** ANMN WA sub-facility.

6e Acoustic Observatories

IMOS_ANMN-AO_B_20080801T000000Z_PAPCA1_FV00.nc

This file would contain raw Biological data starting from the 1st August 2008 at 00:00 UTC and collected at the Perth Canyon 1 mooring site by the **IMOS** ANMN Acoustic Observatories sub-facility.

6f NRS

IMOS_ANMN-NRS_STV_20080801T000000Z_NRSMAI_FV01.nc

This file would contain quality controlled Salinity, Temperature, Current Velocity and data starting from the 1st August 2008 at 00:00 UTC and collected at the Maria Island mooring site by the **IMOS** ANMN NRS sub-facility.

6g Ocean Colour Validation

IMOS_ANMN-SOC_B_20080801T000000Z_CRSLUC_FV01.nc

This file would contain quality controlled Biological data starting from the 1st August 2008 at 00:00 UTC and collected at Queensland Colour Mooring site by the **IMOS** ANMN Ocean Colour Validation sub-facility.

1.2.7 -Facility 7: ACORN

IMOS_ACORN_VW_20081122T133000Z_TAN_FV01.nc

This file would contain quality controlled current Velocity and Wave parameters from the Queensland radar site located at Tannum Sands and Elliot Islands, from the **IMOS** ACORN facility and for the date of 22nd of November 2008 at 13:30 UTC.

1.2.8 -Facility 8: AATAMS

IMOS_AATAMS_B_20081231T013000Z_NL4_FV01.nc

This file would contain quality controlled Biological data starting from the 31st December 2008 at 01:30 UTC collected at location 4 on the North Line acoustic receiver installation of the **IMOS** AATAMS facility.

1.2.9 -Facility 9: FAIMMS

IMOS_FAIMMS_T_20081231T013000Z_HIRP1_FV01.nc

This file would contain quality controlled Temperature data starting from the 31st December 2008 at 01:30 UTC collected on Heron Island Relay Pole 1 by the **IMOS** FAIMMS facility.

1.2.10 - Facility 11: SRS

IMOS_SRS-A_T_20080801T231000Z_AVHRR17-L-AVHRR18-L_FV03_ L3-GHRSST-SSTsubskin-14day-mosaic _C-20081112T125500Z.nc

This file would contain Temperature data in a 'SST subskin' product as a 14 day mosaic from the L3-GHRSST-AVHRR17-L platform starting from the 1st August 2008 at 23:10 UTC, produced by the **IMOS** SRS facility.